The impact of capital account liberalisation on productivity growth: The evidence from Poland since 1995.

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For the Degree of Doctor of Philosophy

University of Sussex

March 2016

Statement

I hereby declare that this thesis has not been and will not be submitted in whole or in part to another University for the award of any other degree.

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Summary

This thesis investigates the relationship between the Capital Account Liberalization (CAL) process and changes in productivity in light of theoretical and empirical studies. It also presents a significant investigation into the nature and evolution of the capital control process, through a cross-country analysis and individual country analysis of Poland during the 1990s and the beginning of the 2000s. In addition, this thesis analyses the determinants of capital controls in the cross –countries analysis. Then, this thesis presents a profile of the Polish productivity distribution across manufacturing sectors, structure and level of the capital control process and sector characteristics, and an analysis of how these have changed over time. The empirical results are derived through an application of the best practices and techniques of productivity estimation on sector level data.

Chapter 1 provides the description of key reforms in Poland and the structure of these thesis. Chapter 2, discusses strengths and weaknesses of various CAL measures and presents different trends of CAL measures. Chapter 3 employs selected CAL measures in a cross-county analysis, investigating the determinants of the CAL process. Chapter 4 analyses the trends of productivity in Poland. Chapter 5 analyses the CAL effect on manufacturing sector productivity by including sector financial dependence, sector investment and trade openness, and then compares this results with sectoral proxy for CAL measures. Chapter 6 concludes by discussing the results and provides a possible avenue for further research.

Acknowledgments

There is a great number of people who supported me in writing this thesis.

The biggest thanks are going to my parents Elzbieta and Stanislaw Sulimierscy, and to my beloved husband Prem Rajah, who supported me financially and mentally through the whole period of my study. They were there for me when I had many moments of doubt to give me a word of comfort and support. Without them and their prayers this thesis, might have not been finished.

My second set of thanks are for my two supervisors at the University of Sussex: Dr. Micheal Gasiorek and Professor Richard Dickens. Dr. Micheal Gasiorek has guided and supported me throughout the process of writing this thesis. He has helped me with my preconceptions and has stimulated me with my data estimation and to create the concept of this thesis. Professor Richard Dickens has provided me with insight into complex econometric issues and has guided me with the data interpretation and understanding complex estimation results.

Thirdly, I must thank Eleonora Abascal, Angela Yankson, Deanna Trejo, Eugenia Aguilar Nova, Dr. Yolande Cooke, Paul Lennane, Janani Ramasubamanian for their individual help with regards to particular problems in writing this thesis and for their amazing mental support in the many moments of darkness I have encountered throughout my research. To Edgar Cooke for his constant intellectual support throughout, passing on some econometrics understanding of the problem of my panel data. Also, to my biggest moral supporter -and best friend Angela Yankson, who has been there for me through all the years with her humor, smile and kind words- without her I do not think my PhD journal would have ever started at all. And to all PhD students at Sussex University and LICOS KU Leuven who provided me with so much intellectual stimulation, support, advice and friendship during my many years here and subsequently.

Fourthly, I would like to thank my colleagues at the University of Sussex, particularly Profesor Emmanuel Maatzakis, Dr. Mike Osborne, Professor Barry Reilly, Professor Andy Mckay and Professor Carol Alexander, for their help and encouragement in completing this thesis. Also, I would like to thank The European Movement for their financial support for my fieldwork in LICOS KU Leuven in Belgium with special thanks to Professor Joep Konings for his kind invitation to come to LICOS KU Leuven.

Finally, I would not have completed this PhD without the help of God - Thank You for the strength to finish this PhD life trip.

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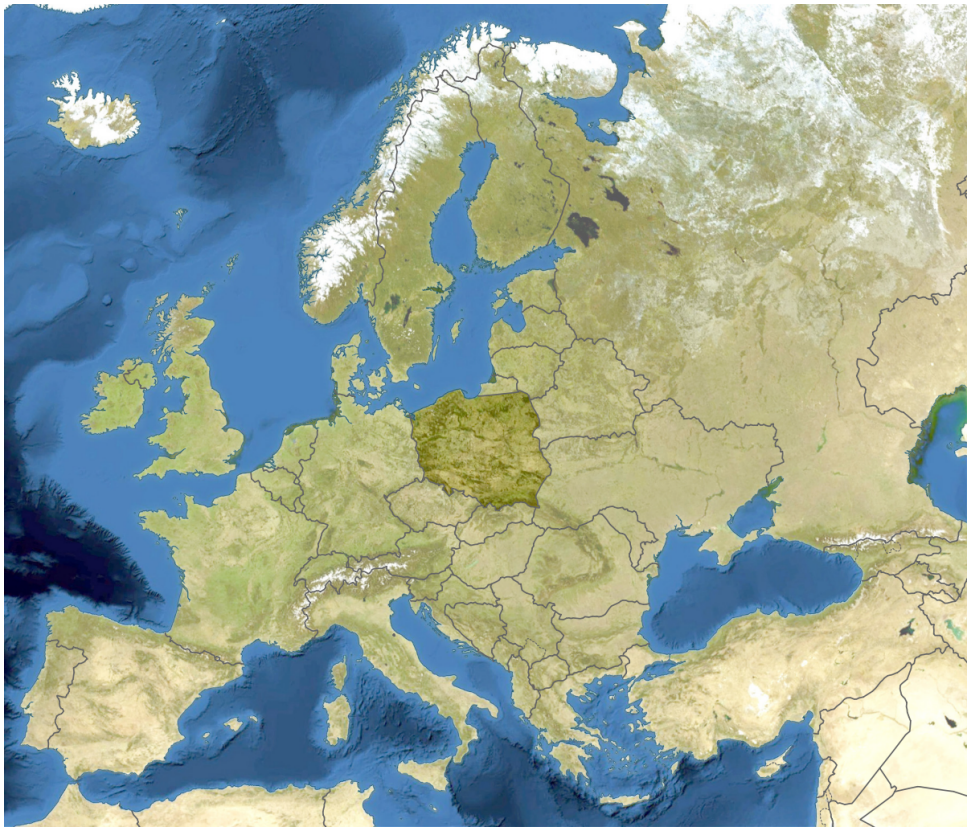


Chapter I: Introduction

This thesis conducts empirical analysis of the impact of capital account liberalization on productivity growth of Polish industries data. However, before investigating the consequences of capital account liberalization and its impact on the Polish manufacturing sector, looking specifically at cross-country analysis will be the first task.

Over the years, many researchers have tried to capture the complexity of real-world capital controls with varying degrees of success and coverage. A natural starting point for any data based discussion, given that the complexity of capital controls policies and regulations are to review various Capital Account Liberalization (CAL) measures; as a result of this, Chapter 2 discusses various CAL measures and their methodological strengths and weaknesses.

The empirical analysis in this chapter also presents a varied analysis of cross-country trends of capital control measures in three different waves, between 1980 and 2006. Also this chapter includes the analysis of the two types of CAL measures, which are de jure and de facto measures. Additionally, this chapter proposes new adjustments in the construction of rule-based measures.

Apart from investigating the pattern of the CAL process, another aim of this research is to assess the extent as to which different factors cause the process of liberalization. Several researchers have investigated the experience of capital controls and reasons for implementing these controls (see Bartolini and Drazen, 1997; Gregorio *et al.*, 2000, Edwards, 1999, Glick and Hutchison, 2005 and Glick *et al*., 2006), based on their analysis, it is possible to define the following determinants of capital account liberalization as macroeconomics imbalances, political stability, monetary independence, trade and balance of payments openness, strengths of political institutions, and economic growth and financial instability possibility. In Chapter 3, empirical cross-country analysis to investigate these determinants of the CAL process are provided.

The primary focus of this research is to analyze the impact of economic growth and financial instability, and the factors that cause capital control episodes. The empirical analysis includes a sample of 75-89 countries, which is consistent with the analysis in Chapter 2. This chapter covers the period between 1995 and 2005. The empirical evidence of this analysis shows statistical evidence for the effect of each of the determinants, especially, financial integrations, monetary independence and political stability.

Secondly, the focus is on micro-economic analysis based on polish manufacturing industrial data. Where, the analysis presented is on the productivity trend in Poland described in Chapter 4 and then, later, in Chapter 5 to investigate the interaction between manufacturing productivity and the Capital Account Liberalization process over a period between 1995 and 2007. Through this perspective, it seems logical to provide a narrative of the Polish economy over this period; focussing mainly on key political changes with special consideration on the Capital Account Liberalization process that occurred in Poland.

Since the fall of the Berlin Wall, most of the countries in Central Eastern Europe (CEE countries) transformed their economy from a totally closed and centrally planned to an almost fully integrated economy with a global market and with liberalization of capital and trade regulations. Furthermore, after the collapse of the Former Soviet Union in the early 1990s, their social structure and political environment also changed, leading to macro-economic problems, such as fiscal deficit, unemployment and high inflation (Taci and Buiter, 2003).

However, between the years 1995 and 2007, Poland was not considered to be in any serious financial crisis or currency crisis, even after the financial crises in Russia and the Baltic Countries. Moreover, Poland was described as a country that was strongly involved in the process of European integration, there was also a shift in Poland's export markets from CMEA countries (former Soviet Union and CEE) to those of the European Union and under the European Free Trade Agreement (Kochanowicz, *et al*. 2005).

In 2004, Poland completely liberalized its capital flow with other members of the EU. However, compared to other CEE countries, Poland was regarded as being "cautious liberalizers", but other Baltic countries and the Czech Republic were known as "rapid liberalizers", these countries liberalized their capital accounts relatively quickly and most

transactions were already unrestricted by the year 1995 (Arvai, 2005, p. 3). In contrast, Poland belongs to another group of countries, which include Hungary, the Slovak Republic and Slovenia, who started a process of so-called "Cautious Liberalization" and only achieved full liberalization in the period between 2001 and 2004 (Buiter and Taci, 2003, p. 131).

The process of capital account liberalization in Poland was done in a step-by-step process, which is presented below in Table 1.1. Poland also adopted a gradual schedule of Capital Account Liberalization by becoming a member of the IMF in 1995 and then, a member of the OECD in 1996 and a member of the EU in 2004.

The criterion of membership for an international organization is a good way for evaluating the degree of capital control regulations because, before accession, the country is forced to impose new laws on capital movement regulations, such as IMF's Article VIII, the European Commission Treaty (Article 56 EC to 60 EC) or OECD's Capital Movement Code. This, therefore, suggests that Poland is a relatively open country to Capital Flows, and that the on/off capital transaction index ($imf_{x,t}$) is based on IMF'AREAER, confirming that Poland liberalized capital flows from 1998. However, this is also worth analyzing further, by looking at different CAL indicators, described in the discussion in Chapter 2 and 5.

The CAL process was started in line with gradual macro-economic development, monetary exchange rate and fiscal policies[1]; at the beginning of these transformations in the 1990s, the National Bank of Poland introduced a fixed exchange rate regime, which was changed to a crawling peg regime in May 1991. In 1994 and 1995 the band for acceptable exchange rate fluctuations was widened. In 1998 the National Bank of Poland began to move from the band of an acceptable exchange rate regime to a full-blown exchange rate regime. In April of 2000, a float exchange regime was fully adopted.

[1] At the beginning of this transformation, Poland had a fixed exchange rate. In May 1991, Poland introduced the crawling peg regime. In 1994 and 1995 the band of acceptable exchange rate fluctuations were widened. Then, in 1998, the National Bank of Poland began to move into full-blown exchange rate regime. In April 2000, the float exchange regime was fully adopted (see World Bank, 2002; Sulimierska, 2008b).

Table 1.1: Capital Account Liberalization process in Poland (1998-2005)

Years	Capital Account Liberalization events
1986	Joint ventures between Polish companies and foreign partners were permitted under certain conditions.
1988	The Law on Economic Activity with the Participation of Foreign Parties was passed - more liberalization than previous Act from 1986.
1989	Permission for buying/selling currencies.[2] The Law on Economic Activity with the Participation of Foreign Parties entered into life. Joint partners were permitted to transfer abroad their profits
XII.1990	Commercial banks could not sell all foreign currency into the National Bank of Poland.
VII. 1991 11 IX 1991	Foreign investors can transfer their profits, repatriation of capital and simplified administrative procedures for joint ventures. Preannouncement of a crawling peg regime of exchange rate.
1992	Foreign investors could purchase long-term treasury bonds (26, 39, 52 weeks) and could freely turnover the 3-years treasury bonds. The first country fund was established in Poland by an American Pioneer Group so called "Pioneer Pierwszy Polski Fundusz Powierniczy"
1993	Acceptance of VIII statues of IMF (e.g. legal descriptions of currency risk). Exchange banks obtained legal permission to acquire the currency from National Bank of Poland to close the currency positions (14.IV.1993). The Finance Ministry Act allowed the transfer of profits from treasury securities abroad (18.V.1993). Foreign inventories could purchase short-term securities bonds (4-8, 13 weeks) (VI.1993).
1994	WTO member (Code on Capital Account Transactions) Free financial flows in the context of all current transactions and balance of payment (02.II.1994). Non-residents can purchase and freely turn over treasury bonds (the buy-out date of which is 1996, 1999 with fixed interest rate and indexed annual government loans (VII. 1994).
1995	Poland notified the IMF and since 1st of June 1996 Poland covenanted to respect IMF statute VIII. Exporters obtained permission to allocate a part of the earnings in foreign currency on account in an exchange bank but they were obliged to bring in the funds from abroad. The obligation of reselling the foreign currency over a period of two months. The only exception was to re-export firms.
1996	OECD member. Permission for purchasing the company's share and participations above the 10% of the vote in a company, the company's base allocated in OECD countries or countries with which Poland has an agreement of mutual investment protection. Realization of the OECD recommendations about FDI and selling the shares and investment fund units by foreign investors. A permit for the Minister of Privatization is required to buy shares of companies in the following sectors: seaport & airport, real estate brokerage, purchase and sale transactions.
1997	Obligations of an immediate transfer of exchange currency from abroad, if this currency were obtained from export. Transfer of domestic currency and ownership of fund units if the residents are abroad (over a period of 2 months). The limit for investments in securities issued in Poland by foreign entities and allowed for public trading by Polish Security and Exchange Commission was raised to ECU 300 million. Insurances were permitted to purchase long-term securities in OECD countries or in the countries that concluded bilateral agreements on investment protection with Poland rated Aaa-Baa by Moody's or A1-A3 (S&P rating) ADR Effective data (Company Mostalal Export CoRR, Exchange OTC) (18.02.1997) Foreign firms will gain seats on the Warsaw Stock Exchange without resistance from Polish companies (XII.1997).
1998	The new foreign exchange law (not law consolidation) between banks and nonbank entities: banks can conduct some short-term capital transactions, while nonbanks need a special foreign exchange permit.
1999	Elimination of most restrictions on convertibility of their currencies for capital transactions; there are some restrictions on investments in non-OECD countries and by their residents and maintains limits on foreign borrowing by domestic financial institutions. Investments in the country's financial markets by OECD residents and institutions are fully permitted. Investment in financial instruments with maturity not exceeding one year is restricted.
IV.2000	Float exchange regime for Polish currency, zloty.
X.2002	All remaining short-term restrictions were eliminated.
2004	Polish accession to EU (V.2004) and Poland adopted Enterprise Freedom Bill. Since 1996, there were not significant regulations for FDI in Poland; however, foreign companies were involved in the purchase of firms in sectors associated with the restructuring. Since 2004, the Polish legal system to protect property rights and investments treats, equally, domestic and foreign companies for participating in private business activity in almost every sector and permits the repatriation of profits and capital.

Sources: Sadowska-Cieslak (2000, 2003); Arvai (2005); Gruszczynski (2002); IMF (1990-2005); Bekaert and Campbell (2002c); Sulimierska (2008b); IMF's AREAER(various years)

[2] There was an obligation that all currencies from export needed to be resold immediately (in 2 months).

On the other hand, even though Poland's fiscal situation was more complicated, generally this period between 1993 and 1995 was relatively stable, and was led by an especially effective government headed by the Prime Minister, Olszewski in 1992, who was responsible for stabilizing polish fiscal policy and also for obtaining accreditation again by international bodies such as the IMF. However, government investment spending was actually low, consistently representing only around 5 percent of the state budget. Then, in 1999 there was financial crisis, the root cause of this crisis brought about the implementation of reforms on the pension system, the education system, the health care system and public administration. From the year 2000, the fiscal situation improved until 2007 (see Kochanowicz, Kozarzewski, Woodward 2005).

Therefore, this strategy of proper sequences of Capital Account Liberalization can be used to demonstrate a preference for long-term flows against short-term flows and liberalized inflows before outflows. With this strategy, the National Bank of Poland implemented a proper sequence of the Capital Account Liberalization process, which was co-integrated with macro-economic stability programs (see Sulimierska 2008b, Bekaert and Campbell 2002c).

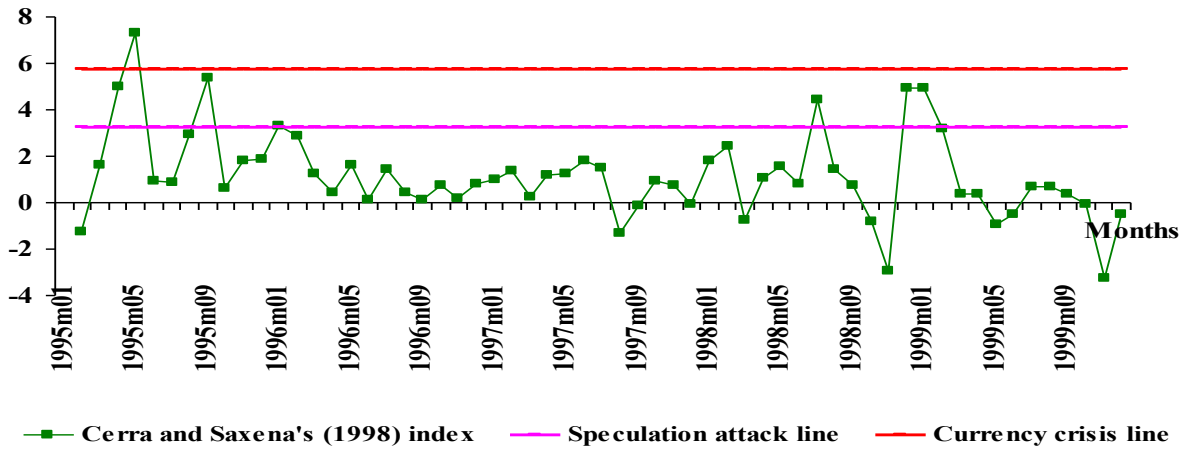
In the beginning of the 1990s, in particular, high external debt, trade deficit and very high inflation, caused the authorities to proceed very cautiously in removing capital restrictions. This was done mainly, in order to decrease the vulnerability of external shocks such as, speculative attacks (see Arvai, 2005, p.8), also during this time, most of the regulations on convertibility to other foreign currencies for capital transactions had already existed.

However, the restrictions on investments in non-OECD countries remained. Moreover, some experts have suggested, that this attitude towards liberalization of capital regulations have helped the Polish economy in avoiding a currency and financial crisis, similar to the events of the currency crises in neighboring countries[3] or also an international economic crash (e.g. Asian crisis) (see Sadowska-Cieslak, 2003, p. 225-243). Hence, it is clear that these incidents had a significant impact on the Polish economy due to the degree of co-integration of the Polish financial market with foreign markets (see Linne, 1999, Orłowski, 1999). For instance, the empirical evidence has also shown, that the Russian and Asian crises had a significant impact on financial indicators and volatility of the exchange rate, but, it did not cause the collapse of the Polish currency and its financial market (see Figure. 1.1), when

[3] Hungary (1994), Czechy (1997), Russia (1998), Ukraine (1998-1999).

compared to other emerging markets in the region, such as, the Russian default.[4] Nevertheless, the National Central Bank intervened on exchange rates on the market in February 1998, in order to reduce exchange rate risk (Gruszczysnki, 2002, p. 143), also, Poland adhered to the new exchange rate mechanism, ERM2, which requires parity between their currency and the euro within a +/- 15 percent margin, which is to be maintained for at least two years prior to qualifying for Stage 3 of EMU.

Figure 1.1: A market pressure index (MPI) trend in Poland



Note: The market pressure index was computed based on Cerra and Saxena's (1998) and Sulimierska (2008 a,b) approaches. The definition of speculative attack was defined by the cut-off point as $MPI_i > \mu_{MPI_i} + 1.5 * \sigma_{MPI_i}$ where μ is the mean of the MPI in country x, and σ is the standard deviation of MPI. The currency crisis is described when $MPI_i > \mu_{MPI_i} + 3 * \sigma_{MPI_i}$. *Source:* IMF's IFS

Considering that the CAL process was intensive in Poland, and that Stock Market Liberalization was taken in as a cautious option. There are three main events with respect to Stock Market Liberalization that are identified below:

1) 1996 was the year, when the Polish government gave non-residents permission to purchase company shares and participation of above 10% for the vote in a company; however, these non-resident companies had to be based in OECD countries or countries with which Poland had an agreement of mutual investment protection. There were also some limits to certain sectors of the economy such as, the seaport and airport, real estate brokerage, purchase and sale of transactions.

[4] Ukraine (crisis 1999), Brazil (1999) (see Sulimierska, 2008b)

2) December 1997, was the year when foreign firms gained seats on the Warsaw Stock Exchange without them residing as Polish companies.

3) The third date is 2004; this was when the Enterprise Freedom Bill was established. Polish government gave permission for foreign ownerships to be part of a closed-end country fund and it is also when the American Pioneer Group established their first country fund in 1992, which was called ”Pioneer Pierwszy Polski Fundusz Powierniczy”. And, the Polish government also gave permission for the issuance of American Depository Receipts on over-the-counter market transactions, which happened on the 18th of February 1997.

This evidence shows the importance of the role of sequences in the Capital Account Liberalization process, and its co-integration with macro-economic stability programs and successful legal frameworks of financial institutions in Poland. This, therefore, suggests that Poland is an example of good co-ordination between Capital Control Regulations and macro-economic policy (see Sadowska-Cieslak, 2003, p. 225-243). The other reform that is strictly related to Capital Account Liberalization is privatization. The Privatization Act of 1990 ensured that privatization took place mainly in two forms, as commercialization and liquidation. As a result of this process, many state-owned companies were transferred to foreign ownership, which was part of the CAL process.

Also this empirical evidence, confirms that the Capital Account Liberalization process was extremely intensive in Poland for the analysed period. However, in order to analyse the interaction between liberalization and productivity, the first step, it was to investigate the trends of productivity in Poland, Chapter 4 analyses the levels of productivity in Poland and trys to answer, what the reasons were impacted that these TFP trends. Data on the manufacturing sector for Poland were used for the empirical analysis; the data was aggregated at three levels of aggregation, for the period between 1995 and 2007. TFP is measured by the adaptation of two different techniques - index measures (non-parametric) and parametric production function estimation (OLS). Both TFP indexes indicate significant TFP upward trend over time. Also, there is a significant discussion, on the different problems

in relation to the methodologies of estimating TFP at establishment (sector and firm) levels and a short description, explaining how to overcome these problems.

The last step of this analysis; is to investigate the impact of Capital Account Liberalization on productivity. Chapter 5 examines the CAL effect on productivity, including sector characteristics such as, financial and liquidity sectoral dependence, sector characteristics through investment policy and trade openness. In order to test CAL's effect on productivity in manufacturing sectors and to find evidence of this relationship, two strategies were used to investigate this. The first strategy employs, the traditional on/off CAL measure, sector financial and liquidity dependence, and their impact on productivity by utilizing and adapting works by Rajan and Zingales' (1998) and Levchenko et al.'s (2009). The second approach, presents several direct new capital transmission channels on sector level and their effect on overall productivity levels. Empirical strategies were adopted with Difference in Difference estimation model by using 22 manufacturing sectors in Poland between the years 1995 and 2007.

Finally, Chapter 6 discusses of the results, which were obtained based on the use of both types of macro-economic and micro-economic data, providing a possible avenue for further research.

Chapter 2: Intensity Measures of Capital Control: Strengths and Weaknesses

Abstract

This chapter describes existing measures of capital control that are typically used in the literature. The analysis suggests why existing measures can be problematic in measuring the extent of capital control. This derives both from the underlying inefficiency of legal capital control regulation, and from difficulties in applying in the capital flow classifications in a consistent manner across countries and across time. In turn this derives from periodic changes to the classifications in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). In so doing this chapter points out the differences between the existing Capital Account Liberalization (CAL) measures and identifies their relative strengths and weaknesses. Given the weaknesses identified, we propose three new rule-based indexes in order to measure the intensity of openness in capital account transactions. The chapter describes how we construct the new indexes and then where our indexes stand in relation to the existing literature. The final part of the chapter provides an analysis of cross-country trends of capital control measures where we use both standard measures and the newly constructed measures. The analysis indicates that there were between 1980 and 2006 there were three different waves of capital account liberalization.

2.1 Introduction

A key objective of this thesis is to consider the relationship between Capital Account Liberalization and economic growth. The existing empirical literature offers conflicting results concerning the effect of capital account openness on growth. [1] One of the possible reason for this ambiguity arises from the difficulty in identifying capital account liberalization (CAL) measures in a consistent manner across a wide set of countries and different time zones. The diverse forms of implementing capital controls across countries, and the differences in government's willingness and ability to enforce these legal regulations, have an impact on the effectiveness of capital controls and CAL measures. These measures are distinguished as either *de jure* or *de facto* measures (see Edison *et al*., 2002,2004; Miniane, 2004; Prasad and Rajon, 2008).

Policy-makers would like to have the luxury of deciding when to decrease or increase the economy's openness to capital flows. However, in practice, this does not happen often. Due to financial innovation and trade liberalization, there are ways to avoid capital control regulations (e.g. mis-invoicing), which could result in the further *de facto* opening of capital accounts. In this way, even the tracking of all the changes related to capital restrictions, within a single country, causes problems (see Miniane, 2004; Sulimierska, 2008b), as well as the construction of aggregate capital control indexes.

There is a wide variety of capital control measures in the literature. The majority of these measures are rule-based and are constructed using dummy variables. For instance, according to the literature review undertaken for this these, over the period 1950-2010, 57 of the 86 papers used the rule-based measures. These measures are based on the published capital control regulations in the IMF's Annual Report on

[1] See link between CAL and economic growth in Alesina et al. (1994), Rodrik (1998), Quinn (1997), Edwards (2000), Edwards (2001), Kraay (1998), Klein and Olivei (2000), Chanda (2001), Arteta et al. (2001), Bekaert et al. (2001), Edwards (2001), Donnell (2001), Reisen and Soto (2001), Edison et al. (2002), Edison et al. (2004), link between CAL and Banking-Currency Crisis episodes: Johnston and Ryan (1994), Martin and Rey (2002), Glick et al. (2000), Tudela (2004), Licchenta (2006), Sulimierska (2008c): between CAL and investments: Le Fort and Lehman (2003), Henry (2003), Ahmed and Azezki (2005), Forbes (2005b), Eiteman et al. (2006): between CAL and welfare implication: Faia (2008), Prasad et al. (2003)between CAL and productivity: Henry and Sasson (2008).

Exchange Arrangements and Exchange Restrictions (AREAER), and the OECD's Code of Liberalization of Capital Movements, or in the annual report of a country's central bank and legal regulations of stock markets (see Chinn and Ito, 2002; Guo and Hutchison, 2004; Sulimierska, 2008b; Henry, 2000, 2003).

However, on/off measures of capital control are limited by the absence of a clear measure of the degree of liberalization and the intensity of controls. Consequently, some researchers have instead used measures of the ***intensity*** of capital controls, based on the underlying capital control legal regulations (see Quinn, 1998; Montiel-Reinhart, 1999). However, constructing a proper measurement scale is also problematic. As a result, other researchers have concentrated on quantitative measures in three dimensions: national savings paired with national investment rates, interest rate differentials in asset price integration and lastly, measured international capital flows (see Feldstein and Horiok, 1980; Holmes and Wu, 1997; Levine and Zervos, 1998; Kraay, 1998; Edison and Warnock, 2001).

Even within the context of quantitative measures, difficulties arise in determining the appropriate benchmark for an individual country. For instance, what level of capital flow is required for a country to be defined as completely liberalized in the capital accounts?

The core aim of this paper is to define the strengths and weaknesses of the commonly used CAL measures, both conceptually and through a cross country analysis. To fulfil this aim, this paper attempts to answer the following auxiliary questions: Why might capital controls not be efficient? Which techniques may be used to circumvent capital controls? Which measures of capital control have already been developed, and what are the weaknesses of these existing measures? In what way it is possible to propose improvements in CAL measures? What trends of capital account liberalization have occurred over the last decades?

Considering all of the above questions, this paper is organized as follows. In Section 2, there is a discussion of the different categories of capital control regulation and the reasons for possible inefficiencies in legal capital control regulations. This is important for understanding the different ways in which CAL may be measured. These measures are discussed in Section 3, which presents a summary of the current CAL measurement

approaches and their empirical implementation in economic research. It also discusses how to improve these CAL indicators. Section 4 provides an empirical analysis that describes the path of the capital account liberalization process in a cross-country sample, and investigates if there are significant differences between the different CAL measures. Section 5 provides a conclusion regarding the properties of the CAL measurements.

2.2. Understanding capital control regulations

Capital controls differ across countries and time periods. Capital controls have been classified into two main categories (see Johnston and Tamirisa, 1998; Arvai, 2005; Henry, 2006; Sulimierska, 2008a):

1. The first category is based on how the policy instruments are implemented in the economy. There are two forms: ***direct control*** (administrative restrictions) and ***indirect control*** (market-based control). Administrative regulations concentrate directly on prohibitions such as the approval procedure for different categories of financial transactions, the limits imposed on the amount of a firm's stock a foreigner could own, the limits imposed on a citizen's ability to invest outside the country, the amount of foreign capital residents may hold, banking obligations for controlling and monitoring of capital flows, and requirements for prior approval. Market-based restrictions try to discourage investors from making risky financial transactions by adjusting the price of a financial transaction. In this way, an indirect capital control method is used to reduce the volume of capital flows. These include differential taxation of cross-border capital flows such as uniform tax, Tobin taxes, reserve requirements, interest penalties or dual/multiple exchange rates (see Gruszczynski, 2002; Kose *et al*., 2006). The coverage of these regulations applies to receipts as well as to payments and actions initiated by both non-residents and residents (see AREAER, 2011).

2. The second category is how capital flows are classified (for instance, Foreign Direct Investments, Foreign Portfolio Investments, and Other Investment)[2]. There are two main channels of capital flows: ***inflows*** and ***outflows***. A restriction on outflows limits domestic residents from acquiring foreign assets, while restrictions placed on inflows restrict foreigners from acquiring local assets. This definition of inflows/outflows capital is important later in the analysis of the CAL sector measures (see Chapter 5.2). However, there are problems with the definition. Firstly, how are transactions, such as invisible or current transfers, classified? And secondly, what is an appropriate definition of resident and non-resident in the context of capital flows?

Apart from an analysis of the different categories of capital control, it is important to investigate the factors that can determine the effectiveness of capital controls. The effectiveness of capital control depends on *"domestic policy"*, the "*issue of time"* and "*the degree to which it is international in scope"*. The effectiveness of the restrictions is important for greater investigation as this factor determines whether the legal regulations are enforced in the real economy, and effectively stem from capital flows. Capital flow categories are not always precise and this leaves room for market participants to circumvent control regulations. The techniques used to avoid capital controls are similar to tax evasion and money laundering (see Table 2.1).

[2] It is important to remember that these categories of capital flows can be imprecise**.** In this paper, the IMF distinction of capital flows was used in the respect to short term assets and liabilities. Foreign Portfolio Investments (FPI) have a contractual maturity of less than or equal to one year. If longer than one year, they are considered as Foreign Direct Investments (FDI). However, in the case of some financial instruments, in particular options and swaps, the original maturity is now of relatively little importance. A good example is a 20-year bond, which may change hands numerous times during those years. The other practice involves multinational corporations, which can, relatively easily, transfer FDI to FPI. For instance, foreign companies can take back secured advances made to its subsidiaries and, in that way, transfer money invested earlier (see Gökkent, 1997; Lipsey, 1999; Duce, 2003; Cowan and De Gregorio, 2005).

Table 2.1: Techniques used to circumvent capital controls

Method	Definition
Transfer pricing	Multinational corporations can engage in transfer pricing with their foreign divisions. It represents financial transactions between subsidiary and parent company for the purchase of raw materials, services and intellectual property from the parent.
Over invoicing of imports, under invoicing of exports, creating unrelated exports	These transactions are part of the transfer pricing process however; it generally includes the flow of goods. The over invoicing of imports comes from inflated costs of goods sold while the under invoicing of export comes from an understatement of sales revenues.
Use of payment leads and lags to effectively lend and borrow abroad	The parent company may transfer profits temporarily between the subsidiary and parent. For example, if the subsidiary buys supplies from the parent and pays for them in advance then this serves as a loan from the subsidiary to the parent. If the subsidiary sells supplies to the parent and the payments are delayed (lagged) then this also serves as a loan from the subsidiary to the parent.
Changing of trade credit conditions	One of the common strategies is to shift capital inflows to sources that are not currently subject to exchange controls, such as redefining capital inflows as trade credits.
Unbundling of capital service payments	The return on foreign investment is composed of compensation for a variety of services from the parent company, for example: management fees (payment for technical expertise, royalties and license fees, payment for proprietary knowledge and intellectual property).
Fronting loans	Loans from the parent company may carry an interest charge that is above the current cost of debt capital which serves to transfer profits to the parent. The subsidiary could also make loans to the parent, perhaps below the cost of market interest rates which would be an effective way of transferring funds from the subsidiary to the parent. If a country's regulations on the transfer of capital prohibits loans from a subsidiary to a parent company but allows the transfer of funds to financial intermediaries, then a fronting loan may be used to achieve a transfer of capital from the subsidiary to the parent. The subsidiary deposits funds in a bank which serves as collateral for a loan to the parent company. The interest on the parent company's loan is offset, at least in part, by the interest received on the subsidiary's deposit.
Special dispensation	Creation of profit centre by multinational corporations (offshore financial centers) which are mainly located in tax havens.[3]

Sources: Author's analysis bases on Desai *et al*. (2004); Forbes (2007); Mathieson and Rojas-Suarez (1993); De Boyrie *et al*. (2001); Zdanowicz *et al*. (1999).

[3] Tax havens impose no more than nominal taxes on non-residents; these are mainly lower than that of the taxation in their country of residence (see Sohn 2002). According to the OECD, there 35 jurisdictions identified as tax havens: Andorra, Anguilla, Antigua, Aruba, Bahamas, Bahrain, Barbados, Belize, British Virgin Islands, Channel Islands of Guernsey, Sark and Alderney, Cook Islands, Dominica, Gibraltar, Grenada, Isle of Man, Jersey, Liberia, Liechtenstein, Maldives, Marshalll Islands, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, St Kitts and Nevis, St. Lucia, St. Vincent, Seychelles, Tonga, Turks and Caicos, US Virgin Islands, Vanuatu, Western Samoa.

2.3. CAL measures

As previously discussed in the literature CAL measures are defined variously with differences in terms and terminology used.[4] Compared to the existing literature surveys, this paper concentrates on the practical aspects of the CAL measures in economic research, and distinguishes them with respect to their usage in micro or macro-economic studies[5]. Furthermore, this survey tries to identify the weak and strong points of the CAL measures used.

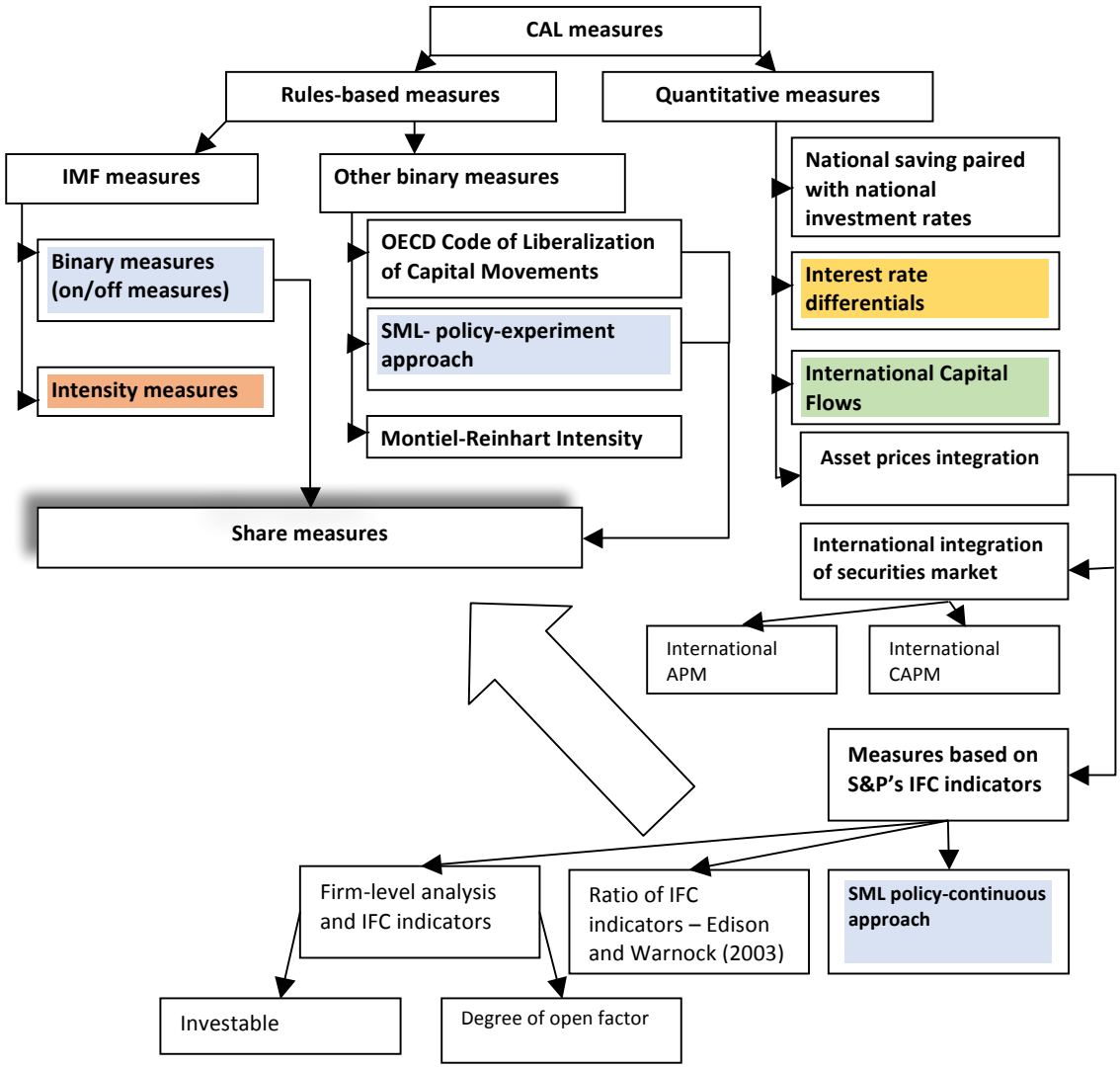
There are two core categories of the CAL measures: *Rules-based measures* and *quantitative measures*: this classification is described in Figure 2.1. Rules-based measures are based on existing legal regulations, while quantitative measures measure actual flows.

In order to facilitate the analysis, a colour coding has been implemented in this chapter. Each colour represents a different category of CAL measures: "**blue**" is used for on/off measures, "**orange**" is used for intensive measures, "**green**" is used for the use of an International Capital Flows index, and lastly "**yellow**" is used for measures based on interest rate differentials (see Figure 2.1). The coloured measures identified in the table below are then the ones which are used later on in this chapter when we turn to the trend analysis.

[4] Eichengreen (2001) and Kose *et al*. (2006) concentrate on discrepancies between the legal (*de jure* measures) and the actual degree of capital controls (*de facto* measures). On the other hand, Edison *et al*. (2002) and Sulimierska (2008b) divided the CAL measures on rules-based measures and quantitative measures. Other researchers (see Prasad *et al*., 2003) focus more on measures of financial openness and degree of financial integration. Frankel (1992) only concentrates on the S-I correlation, real interest parity and uncovered interest parity - so mainly on the *de facto* measures. These include the international capital mobility index (see Feldstein and Horiok, 1979; Obstfeld, 1986 a, b; Swan, 1998; Frankel, 1992; Montiel, 1994; Edwards, 2001), financial openness index (Kray, 1998), Stock Market Liberalization index (SML) (see Henry, 2000 a,b; 2003), financial globalization measures (see Lane and Milesi-Ferretti, 2005 and 2006).

[5] A macroeconomic perspective is analysis at the cross-country level; microeconomics is analysis at the sector or firm level.

Figure 2.1: CAL measures classification



Source: My own analysis based on Eichengreen (2001); Kose *et al*. (2006); Edison *et al*. (2002); Prasad *et al*., (2003); Frankel (1992); Feldstein and Horiok (1979); Obstfeld (1986 a,b), Swan (1998); Frankel (1992); Montiel (1994); Edwards (2001), Kray (1998); Henry (2000a,b, 2003); Lane and Milesi-Ferretti (2005, 2006).

2.3.1. Rules-based measures

Rules-based measures are divided between on/off measures and intensity measures. The IMF index is the most commonly used on/off measure in the literature; this index utilizes the information from the IMF's AREAER report. Apart from the IMF-based indicators, there are other measures: OECD Code of Liberalization index, SML (stock market liberalisation) policy-experiment approach, and the Montiel-Reinhart index.

Table 2.2 presents the evaluation of the categories and subcategories in the IMF's AREAER report. Up to 1996 this report disaggregated capital account transactions into 12 subcategories, and then from 1997, an additional subcategory ("Personal Capital Movements") was added.

Table 2.2: The categories in IMF's AREAER report over the period between 1994 and 2006.

IMF's AREAER categories	1994-1995	1996	1997-2006
1.Status under IMF Articles of Agreement			
2.Exchange rate arrangements	X		
3.Exchange rate structure	This section belongs to above section and includes the following categories: *Separate exchange rates(s) for some or all capital transactions and/or some oral or all invisibles, more than one rate for imports, more than one rate for exports, import rates (s) different from export rates(s)*		
4.Arrangements for payments and receipts			
5.Controls on payments for invisible transactions and current transfers	Different name: *Restriction on payments for currents transactions* and belongs *to section* ***Payment Restrictions***		
6.Proceeds from exports and /or invisible transactions	Different name: *Export Proceeds*		
7.Capital transactions	Different name*: Restriction on payments for capital transaction* and belongs to section ***Payment Restrictions***		
Capital markets	X		
Money market instruments	X		
Collective investment securities	X		
Derivatives and other instruments	X		
Commercial credits	X		
Financial credits	X		
Guarantees, sureties and financial backup facilities	X		
Direct investment	X		
Liquidation of direct investment	X		
Real estate transactions	X		
Personal capital transactions	X	X	
Provisions specific Commercial banks and other credit institutions	X		
Provisions specific Institutional investors	X		

Notes: My own analysis based on IMF's AREAER reports. This empty cell – this category exists in IMF's AREAER, X- this category exists

The principles underlying the IMF on/off measures are essentially based on the "*Capital Transaction"* category from the IMF's AREAER report. This typically means that, if a country has restrictions on different forms of capital transactions or a certain number of these transactions, the index is equal to "0", otherwise it is "1". For example, Glick *et al*. (2004) proposed that a country would be considered 'closed' if it had controls in place for the "Financial Credits" subcategory plus at least four other subcategories. Hence controls on a minimum of five subcategories were needed in order to classify a country as closed and at least one of these five had to be 'Financial

Credits' subcategory. This index is 0/1 indicator, where "1" means opened country, otherwise it is "0".

However, on/off indicators based on analysing the subcategory "*Capital Transaction"* in the IMF's AREAER, can provide misleading information depending on the coding of missing values and blank cells – which are often present in the reports. These missing values / blank cells are treated differently by different authors. The missing values occur when '*the data was not available at the time of publication'* in the IMF's AREAER. In the literature they are often interpreted as representing the lack of a capital control regulation, and which therefore gives the value "0" for the on/off measure. For instance, if you take the subcategories of the "*Capital Transaction"* category in the IMF's AREAER report, that there are 99.9% of missing values in the *Money market instruments* subcategory for the period between 1998 and 2006. The number of the missing values for the other subcategories in the "*Capital transaction"* category ranges between 2% to 12% of observations. Interestingly, previous surveys such as Edison *et al*. (2004), Miniane (2004) and Prasad and Rajon, 2008 of CAL indicators do not address these problems. Conversely, the presence of blank cells in the report are typically defined as meaning there is 'no specification regulation' in the literature which is, then given a value of "1" for the on/off indicator (i.e. the capital account for that country is considered as open). In reality, however, this cell does not include any information about the CAL process and the allocation of "0"-"1" is somewhat arbitrary. In this way, these indicators may not provide an accurate picture.[6]

In addition, the on/off measures do not measure the ***intensity*** of the controls or their efficiency. In order to overcome this problem, a "*share*" measure was constructed by some authors (see Harvey and Lundblad, 2002b; Chinn and Ito, 2008). The share measures represent the proportion of years that the capital account was registered as

[6] This variable was coded by using three different methods: "0" - if there are specific practices in a feature of the exchange system, when a missing variable in the data was not available at the time of publication; and "1" - if the specific practice is not regulated or a blank cell (no information). In this case "0" indicated that the country has regulations in the context of the CAL process. In contrast, "1" states that there is no regulation in the policy area (blank window); there were essential changes that were implemented in Exchange Rates Arrangements.

free of capital restrictions over the number of analysing years.[7] However, this share measure cannot be used in cross-time analysis as it does not vary over time.

There are then other intensity indices designed to try and overcome some of the deficiencies of the on-off measures outlined above, such as Quinn's (1997), Chinn and Ito's (2002, 2008), and Mody and Murshid (2004). Chinn and Ito's (2008) financial openness index is the most innovative and most frequently implemented in empirical studies. This index is computed as the first standardized principal component of the four categories from AREAER, such as exchange rate structure, controls on payments for invisible transactions and current transfers, restrictions on capital transactions, and proceeds from exports and invisible transactions (see Table 2.2). Each of the four components is the share of the last five years (including the observed year) when the capital account was open, the non-existence of multiple exchange rates, the openness of the current account, and no obligation for the surrender of export proceeds. The higher the value of this index, the more open a country is.

However, the measures discussed above do not consider the changes in the methodology of IMF's AREAER. Since, 1996 the "Capital transaction" category has been subdivided into 12 subcategories and, in 1997, the IMF added a further category resulting in 13 subcategories. In order to capture the changes in IMF's methodology, the ***first of the new measures*** proposed in this chapter is a measure of capital controls intensity which is based on summing the subcategories of the "*Capital Transaction"* category in the IMF's AREAER. This measure is computed after 1998, so that it is the sum of the 13 subcategories, and takes into account the changes introduced in the report. This measure is denoted as the *Capital Transaction Index* in the empirical analysis in Table 2.5. This measure analyses the changes in the legal regulations without considering the effect that these changes have on the actual capital flows.[8] On/off indicators computed based on misleading information as the result of coding

[7] Some researchers such as Rodrik (1998), Klein and Olivei (1999), Edwards (2001) and Chanda (2001, 2005) used different definitions of "share" measures. The "share" measure is then defined as the capital control index, which is calculated by dividing the number of years it had controls in place by the length of that period.

[8] In this case, blank cells and missing values in IMF'AREAER report are treated the same way as in the standard procedure in the literature.

missing value and blank cell from subcategory "*Capital Transaction"* in IMF's AREAER might cause misdirected information.

This chapter also proposes a ***second new measure*** based on Chinn and Ito's (2008) index and Glick *et al*.'s (2004) index. This measure is denoted as *new measures based on Chinn and Ito's index* in the empirical analysis in Table 2.5. The cross-country sector analysis of Chapter 3 then applies this new indicator to measure the degree of capital liberalization at the macro-level.[9] Similar to Chinn and Ito's(2008) index, the index was calculated on the basis of dummy variables from IMF's AREAER: exchange rate structure, controls on payments for invisible transactions and current transfers, restrictions on capital transactions, and proceeds from exports and invisible transactions (see Table 2.2). The capital transaction index was computed in a similar way to Glick *et al*.'s (2004) index.

In order to eliminate the problem that occurs when 50% of the subcategories indicate a closed country and 50% the opposite, the ten subcategories in the "*Capital Transaction"* category do not point out that a country was closed or open on individual basis. Instead, if a country has restrictions in place in six or more subcategories of the capital transaction, then the dummy variable is equal to "1" (a closed country), otherwise it is equal to "0" (an open country); information is available for the ten subcategories.[10]

An alternative measure that is also used in the literature is based on stock market liberalisation (SML) information. The SML-policy-experience index is also an example of an on/off measure. In principle, the index identifies the date on which the government allows foreigners to purchase securities which are issued on the domestic stock market[11], or for domestic firms to list their stock on foreign markets (see Henry 2000a, b, 2003; Bekaert, 1995; Mitton, 2006). However, in practice in many cases, either the

[9] There was a problem with the IMF's AREAER report for 1998; this report was not available (missing) in a library of the National Bank of Poland, which causes the analyzing sample to be short. The reason for choosing this particular period is because it allowed the creation of consistent CAL variables.

[10] There are three conditions such as Case A). A proportion of the value "0" and "1" is equal among the 11 categories because there are missing values in some of the categories. Case B) A proportion of value, the "1" is higher than "0" among the 11 categories because there are missing values in some of the categories. Case C) The last situation of missing value problems, is a case where the proportion of value "1" is lower than "0" among these 11 categories. Therefore in that case, Glick *et al*.'s (2004) index is equal to zero. The detailed information about this measure is in Table 2 in Appendix 2.

[11] This index has been called the official equity market liberalization indicator (see Bekaert *et al*., 2005).

dates are unknown or a specific date is not obvious because the policy decree is a gradual process, not a single event. In this situation, proxies have been utilized such as permission for foreign ownership in closed-end country fund, permission to establish a fund or for the issuance of American Depository Receipts with domestic firms (ADR)[12] (see Henry, 2000a, b, 2003; Bekaert *et al*., 2005; Mitton, 2006). The SML-policy-experience index is a less accurate measure of the CAL process because it considers only a small part of the whole process. In addition it does not provide information concerning the intensity of the liberalization process.

2.3.2. Quantitative measures

Rules-based measures do not always capture all aspects of the CAL process because of inefficiencies in the implementation of regulation. Moreover, rule-based regulations might be more volatile over time and more likely to measurement error. Also, these measures do not capture two-way flows, which does not allow for the observation of sharing risk efficiently across the borders with the use of multiple financial instruments and the investors' difference of the risk through diversification of an investment portfolio. Additionally, it is important to keep in mind that capital account liberalization is typically considered as a significant predecessor to financial integration (see Kose *et al*., 2006).

Consequently, quantitative measures are usually based on four main categories of actual economic indicators, such as *international capital flows, national saving paired with national investment rates*, *interest rate differentials* and *asset price integration* (see Edison *et al*., 2002; Eichengreen, 2001; Sulimierska, 2008b). The weakness of quantitative measures is that they are more endogenous than rules-based indicators (see Dolley and Chinn, 1995; Eichengreen, 2001; Chanda, 2005). There are two issues: firstly, market participants might anticipate market liberalization and act prior to the

[12] An American Depository Receipt (ADR) is a negotiable certificate issued by a US depository bank that represents ownership in the shares of a foreign company that is trading on American financial markets. ADRs are denominated in US dollars, allows the right to receive dividends and to vote, and can be traded like the shares of US-based companies (see Karolyi, 2003 and Mitton, 2006). This index has been called the first sign equity market liberalization indicator (see Bekaert *et al*., 2005).

declaration date (see Chari and Henry, 2002b). Secondly, the capital flow indicators might not only be affected by the CAL process but also by a range of other rules connected with fiscal, monetary, exchange rate policy or environmental factors, to cite some (see Stulz, 1999 and Eichengreen, 2001). Ultimately, these measures might analyse the effect of capital control liberalization instead of a measure of the CAL process (see De Gregorio *et al*., 2000).

International capital flows

The first group of quantity based measures is based on actual capital flows across borders as a ratio to GDP. These measures allow for a comparison of the effects of financial integration among countries. However, Kose *et al*. (2006) argued that gross flows are relatively less volatile so that these flows cannot often be used as measures of openness.

Principally, this group of indexes is divided into two subcategories: i) *a sum of gross inflows and outflows as a ratio of GDP*, and ii) *the sum of gross or net stocks of foreign assets and liabilities as a ratio of GDP*. The first subcategory is analogous to measuring trade openness.

Essentially, Swan (1998) and Kray (1998) totalled the annual inward and outward foreign direct investment, portfolio investment and other investment items in the financial account, of the balance of payments, as a share of GDP. Swan (1998) incorporated a narrower definition of 'other investments' by only including the short- and long-term finance and resident sectors.

The second subcategory includes indicators that measure openness as gross (net) flows of liabilities and assets, instead of using measures based on inward/outward capital flows (Lane and Milesi-Ferretti 2001, 2005 and 2006) (LMF). This approach reduces measurement error because changes in liabilities and assets tend to be less volatile, compared to annual inward/outward capital flows (see Prasad *et al*., 2003; Kose *et al*., 2006). Following LMF (2001, 2005 and 2006), these measures involve calculating the gross level of external assets and liabilities as a ratio of GDP, together with direct investment and portfolio equity assets as a share of GDP.

It is worth noting that the separation line between the two classifications is not strong. The first subcategory of the CAL indicator is an implementation of items for the financial account in the balance of payments. The second subcategory is based on all transactions in this account that are associated with changes of ownership in foreign financial assets and liabilities of an economy.

These indicators are often taken to be an imperfect indicator of capital mobility (capital control) mainly for two reasons. Firstly, capital flows might not necessarily occur between strongly integrated financial markets. This is because continuous equalization of the prices of financial assets would remove incentives for such flows (see Montiel, 1994, p. 5). Secondly, the results are difficult to compare. It is, therefore, also difficult to make conclusions about benchmarks in the context of a country and the size of its index. For instance, the answer to the question: "Should it be 50% of the GDP or 10% of the GDP?", will often depend on the sample of countries analysed. For more accuracy, Montiel (1994) proposed a benchmark above 5% as the definition of an intermediate degree of integration with external financial markets.

National savings paired with national investment rates

The greater openness of capital accounts could impact on economic performance through the savings-investment channel. The pioneers of this approach are Feldstein and Horioka (1979). Feldstein and Horioka's (1980) method points out that the small size of average current accounts, over long periods, is evidence that substantial barriers impeded the international movement of capital (where a current account is understood in the traditional way as the difference between savings and investments). However, this approach was strongly criticized by Obstfeld (1986a, b), Edwards (2001) and Prasad *et al*., (2003). The assumption of perfect capital mobility is essentially inconsistent with the traditional Keynesian interpretation that exogenous changes in the level of investment causes income to vary until the resulting savings level equals investment. In this case, there is a serious problem of endogeneity because i) fiscal policy might be incorporated into changes in the current account balance, ii) geographical units share a common currency, and iii) international interest rates might be influenced by the specifics of a country policy or its economic size.

Interest rate differentials and assets price integration

Other quantitative measures include the analysis of prices and returns on different financial transactions, through the investigation of various interest parity condition measures and the asset price-based approach (see Frankel, 1992; Edison *et al*., 2002; Kose *et al*., 2006). These measures concentrate on the real effects on economic indicators such as asset prices and interest rates. However, if liberalization is anticipated by the market, prices may be adjusted prior to that date (see Chari and Henry 2002b).

Interest rate differentials

According to the interest parity condition under perfect financial integration and with a constant exchange risk premium, the nominal return on an asset denominated in the domestic currency should be equal to the return on an identical asset denominated in the foreign currency. However, the financial world is not fully integrated and thus the exchange risk is difficult to eliminate; this causes the difference between international and domestic savings and investment interest rates. On this basis, the aim is to measure the degree of integration of capital markets rather than the degree to which decreases in national savings crowd-out investment.

Hence such measures focus on the differences in rates of return across countries instead of analysing correlations between savings and investment. Empirically to measure capital mobility requires a comparison of nominal yields on “onshore” and “offshore” assets, denominated in the same currency. A greater difference between onshore and offshore interest rates implies that the country is less capital account liberalized (see Obstfeld, 1986a; Edwards, 2001; Edison *et al*., 2002). There are many reasons for the existence of interest rate differences; one of these is an absence of capital mobility.

Generally, there are three main ways of proceeding: (i) deviation from covered interest parity (CIP); (ii) uncovered interest parity (UIP); and (iii) real interest parity

(RIP).[13] On a practical level, the UIP test causes interpretation problems since the two assumptions – risk-free rates and the lack of capital account liberalization – have the same impact on the measure (see Obstfeld, 1986a). Other empirical work on CIP and UIP uses new proxies for capital control, such as the black market foreign exchange premium. When the financial market is not efficient, changes in black market foreign exchange premiums can represent capital immobility (see Saxena and Wong, 1999; Arteta *et al*., 2001; Chinn and Ito, 2002).

Chanda (2005) follows the same line of work by proposing a new measure for the black market foreign exchange premium. This measure is constructed by using two sub-categories from the Economic Freedom of the World Annual Report (EFWAR) where each subcategory has a 50% weighting. These subcategories are "the freedom of citizens to own foreign currency bank accounts domestically and abroad", and the "difference between the official exchange rate and the black market rate".[14]

To sum up, similarly to the Capital Flow Index, the interest rate differential measures are imperfect ways of capturing capital account liberalisation, and are also subject to problems of endogeneity associated with monetary policy objectives or fiscal expansions, which can impact on interest rate levels.

Assets price integration

The logic behind price-based measures and asset market integration measures is analogous to the logic above with respect to interest rate differential measures. This type of measure is founded on the parity test, arbitrage test and capital assets pricing model (CAPM), and belongs to the stock market liberalization (SML) continuous approach (see Levine and Zervos, 1998a, b; Bekaert, 1995; Kose *et al*., 2006).

[13] The following have employed this line of empirical literature; Edwards (1985, 1989); Edwards and Khan (1985); Haque and Montiel (1990); Reisen and Yeches (1993); Dooley *et al*. (1997); Sun (2000); Venugopal *et al*. (2006).

[14] However, in the earliest version of Economic Freedom of the World: 2008, these indices 4A and 4B are located in different sub-categories. The 4A is 3D in the subcategory, "Access to sound money" and 4B is 4D in the subcategory, "Freedom to Trade Internationally" (see Table 1 in Appendix 2).

There are two groups: i) *international integration of securities market*; ii) *measures based on Standard and Poor's International Finance Corporation (IFC) indicators such as the Investable index (IFCI) and a Global index (IFCG).*[15]

The integration of international security markets can in turn be divided into two perspectives: *the International Arbitrage Pricing Model (IAPM) and a cost of capital* or *the International Capital Asset Pricing Model (ICAPM)*. The real integration of capital markets should be reflected in common identical costs of capital across national borders. If a country has a higher cost of capital, then investors will invest in another country, where capital is less expensive. In this situation, liberalization causes a fall in the cost of capital (see Henry, 2003 and Kose *et al*., 2006). The other way to evaluate the impact of CAL, on the cost of capital, is through an estimation of the mean excess return on the market, based on the CAPM model analysis.

Measures based on Standard and Poor's International Finance Corporation's indicators

These are divided according to three approaches:

i) *SML policy-continuous approach (SML-mixed approach)*;

ii) ii) *a ratio of IFC indexes such as IFCG and IFCI*, and

iii) iii) *firm level analysis and IFC index*. These are discussed below.

SML policy-continuous approach (SML mixed approach)

Instead of using the policy decree dates with respect to permission for foreign ownership in closed-end country funds or ADR, two other proxies are employed in the SML policy-continuous approach. The first proxy uses the number of country funds and cross-listed securities on the domestic market (see Bekaert, 1995). The second proxy indirectly captures the domestic security implementation dates via monitoring the IFCI index changes (see Henry, 2000 a, b; Gupta and Yuan, 2005).

[15] International integration of security markets is analyzed by Bekaert (1995), Stutz (1995, 1999), Levine and Zervos (1998a, b), Chari and Henry (2002b), Campbell and Hamao (1992). Measures based on Standard and Poor's International Finance Corporation's indicators are described by Bekaert (1995), Henry (2000a, b, 2003, 2006), Edison and Warnock (2003), Mitton (2006), Chari and Henry (2002b), Bekaert *et al*. (2002, 2005, 2009), and Gupla and Yuan (2005).

The IFCI is the ratio of the market capitalization of stocks that foreigners are legally entitled to hold for total market capitalization. A large jump in the investable index provides indirect evidence of official liberalization. Consequently, the policy experiment literature defines the date of a country's first stock market liberalization as the first month with a verifiable occurrence of an increase in the investable index beyond a certain threshold. Henry (2000a, b) and Gupta and Yuan (2005) define this threshold as 10%. In contrast, Chari and Henry (2002b) suggest that decisions by a country's government to open its stock market to foreign investors is defined when the date corresponds to the earliest stock market liberalization after December 1988 (the date when the IFC introduced its IFCI index). The lack of agreement amongst researchers about the appropriate threshold makes use of these measures somewhat inconsistent.

Ratio of IFC indexes (SML indicator continuous approach)

This method follows Bekeart (1995), and Edison and Warnock's (2003) approach. Bekeart (1995) proposed a ratio between IFCI and IFCG[16] and then Edison and Warnock (2003) built on it:

$$EW_x = 1 - IFCI_x / IFCG_x$$

where x is a country and uses the monthly stock market data.

The ratio of market capitalization for a country's IFCI and IFCG is a quantitative measure of the availability of the country's equity to foreigners and one minus the ratio, is a measure of the intensity of capital controls. The Edison and Warnock's index varies from "0" to "1", where "0" represents a fully open market with no restrictions, and "1" indicates a completely closed country. This measure has a more gradual nature in the SML policy-experiment approach. This is because, instead of estimating the one-time response of the stock market, it observes the changes in returns yields, divided

[16] The IFC's investable index is a monthly measure designed so that a portion of the market is available to foreign investors; then a Global index (IFCG) is designed to represent market capitalizations. Market capitalization is measured as $\sum_{i=1}^{n} P_i * N_i$ where P is a current share price, N is the number of share in issue by i company, n is the number of public limited companies on the stock market. The SML indicator *continuous approach* term was developed by Henry (2006).

yields and capital cost (see Bekeart *et al*., 2002, 2005, 2009; Henry, 2006). In so doing, it provides a better explanation of the impact of CAL on a real economy at a given time.

Firm level analysis and IFC index

Chari and Henry (2002b) and Mitton (2006) employed an SML continuous approach at the firm level, based on the IFC index. The approach employs two indicators: the "*degree of open factor"* and the "*investable"* designation.

The first indicator ranges from "0" to "1", where "0" is a situation that no stock, in a legal sense, is available to foreign investors and where "1" is the opposite. The similarity of openness across firms within a given country suggests that either the liberalization decision is exogenous to any given firm or all firms, within a given country, or that they uniformly prefer the same degree of permissible foreign ownership (see Chari and Henry, 2002b).

The second indicator discriminates between investible and non-investible firms. It is a dummy variable equalling "1" if a firm is investable in year t and "0" for non-investable firms. Investible firms are defined as a subset of firms that are in both the IFCG and the IFCI by December of the same year. The IFC defines a firm as investible when its stock is free from country-level and firm-level restrictions on foreign investment.[17] It requires stock to be sufficiently liquid to be realistically available to foreign investors (see Chari and Henry, 2002b; Mitton 2006).

An analysis of 17 different sources of SML indexes affirms that there is a significant lack of consistency with respect to the liberalization date among different data sources, even where these indicators have used similar criteria (see Table 1 in Appendix 2). In order to overcome this lack of consistency, in this paper a new SML measure was constructed for 49 countries. This is **third proposed new CAL measures** and is denoted as *SML index* in Table 2.5. Compared to previous Stock Market Liberalization analysis, this dataset included a larger sample than previous studies. The SML index is 0/1 indicator, which means that if a country has restrictions on different forms of stock

[17] The first criterion screens for a minimum investible market capitalization of $50 million or more over the 12 months prior to a stock's addition to an IFCI index. These investible market capitalizations are determined after applying the foreign investment rules, and after any adjustments because of cross-holdings or government ownership (see Chari and Henry, 2002b).

market exchange, the index is equal to "0", otherwise it is "1". Table 3 in the Appendix 2 provides a detailed description on which stock market regulations and equity changes were considered in deciding whether a country was considered to be officially liberalized.

The firm-level measures present three main advantages. First, this approach avoids the problem of trying to identify country level liberalization dates. Instead, it identifies firm-specific dates on which individual stocks become open to foreign investors. Second, firm-level dating largely eliminates the concern that results may be driven by economic reforms other than CAL. Finally, these contributions might resolve the endogeneity problem through the use of other econometric strategies.[18] On the other hand, there is still an unresolved problem in the practical sense. The SML continuous approach might not be applicable for analysis of emerging markets and low-income developing economies, at the firm and country levels. This is due to the lack of domestic stock exchanges and problems of data availability.

To summarize this review of CAL measures, the preceding discussion has detailed the key measure that are typically used in the literature. As discussed each of these have their limitation – in part conceptual, in part practical. In response to some of the limitations this chapter has proposed three new rule-based measures designed to improve the analysis of capital account liberalisation. These three measures are:

1. A *new measure based on Chinn and Ito's (2008) index*,

2. An intensity measure, the *Capital Transaction index*, and

3. A stock market liberalisation measure – the *SML index*)

2.3.3. Empirical summary of CAL measures used in the empirical literature

After discussing the strengths and weaknesses of CAL measures, this section investigates how CAL measures have been employed in empirical studies. The majority of empirical studies have analysed the link between the CAL process and other

[18] Fixed effects estimation: firm-level controls for growth opportunities and intra country cross-sectional tests - the issue of causality (see Chari and Henry, 2002b).

economic indicators. However, it is worth adding that some of them (such as Minine, 2004; Lane and Milesi-Ferretti, 2006a; Chinn and Ito, 2008) simply concentrated on proposing new measures of capital account openness. This literature review based on 86 papers.[19] There are two main parts to the review: the first addresses data sources and the second addresses the scope of the analysis.

Data Sources

Table 2.3 below presents the number of papers by type and analytical perspective. This literature review was comprised of 60% individual country studies and 80% which utilized annual data. As the table below shows the database based on the IMF's classification of capital controls has been widely adopted by many authors in the country perspective and industry analyses.

For instance, the IMF's database was adopted in 65% of the empirical studies; and 91% of these studies were country case studies. 86% of these analyses adopted the IMF's AREAER database. Other sources were used 70 times out of 81 analyses (86% of all papers), and 42 out of 66 analyses had a country specific perspective analyses (63% of papers with other data sources). However, 61% of other analyses also used IMF's databases in comparison to other indicators; 40% of them adopted IMF's AREAER database.

Table 2.3: An empirical literature review about capital account liberalization and financial integration

	No	Annually collected data	Monthly data	IMF's database	Other source
Total (sum of 1,2)	**86**	**69**	**16**	**57 (A-38)**	**70 (IMF-43,A-28)**
Country panel analysis	57	46	10	51 (A-34)	42 (IMF-37,A-24)
Industry analysis	**29**	**23**	**6**	**6 (A-4)**	**28 (IMF-6, A-4)**

Notes: A- CAL index based on IMF's AREAER, IMF-CAL index based on the IMF database: Annual Report Exchange Arrangements and Exchange Restrictions Report (AREAER), Balance of Payments Yearbook (BoF), World Economic Outlook, Special Data Dissemination Standard (SDDS), Coordinated Portfolio Investment Survey (CPIS) and International Financial Statistics (IFS), E- IFC's EMDB (International Finance Corporations' Emerging Markets Data Base). *Source*: Author's own calculation based on literature review of 86 papers

[19] This review also contains trade liberalization indexes in addition to an analysis of the restrictions on foreign companies (index of FDI) or equity market liberalization. Here, trade restriction might be treated as capital flow boundaries. The total analyzed sample consists of 86 papers, with one additional descriptive study of an online database: Bekaert and Harvey (2005).

Scope of analysis

This literature review presents the relationship between the CAL measures categories and the scope of the analysis. According to this, there are 234 measures of CAL that were adopted in the macroeconomic and microeconomic analysis reviewed (see Table 2.4 below).

The majority of the CAL indicators (59%) were used in a macroeconomic perspective, where 57% were quantitative measures and 42% were rules-based measures. Among all the quantitative measures, international capital flows and asset price integration were the most frequently selected, accounting for 39% and 29% of all quantitative measures respectively. The SML policy approach was the most utilized indicator among the rules-based measures. The other implementation of the rule-based measure indicators were made among all samples (between 19-25%); the only exception was the control variable by Henry and Sasson (2008).[20] From a variety of different studies in this empirical review, it is possible to conclude that the majority of empirical studies were based on capital flow indicators and rule-based measures using IMF's data sources.

[20] IMF index and on-off measures based on IMF's AREAER comprised 19% of all rule-based measures. Other on-off measures based on measures other than IMF's AREAER comprised a further 20% of all rule-based measures; the intensity of the controls of the IMF index-based IMF's AREAER were included in 25% of all rule-based measures.

Table 2.4: Frequency usage of CAL measure categories via an analysis scope

	All empirical analysis	Country perspective analysis	Industry perspective analysis
Total number of CAL measures implementation	**234**	**139**	**95**
The quantitative measures	**135**	**75**	**60**
National Saving and Investments	7	7	-
International Capital Flows	53	22	31
Interest rate differentials	12	12	-
Assets prices integration	40	20	20
Correlation of rule-based measures and quantitative measures (Bekeart, 1995)	2	2	-
Trade liberalization measures	18	11	7
Regional index for the world (Bekaert, 1995)	1	1	-
The measure of FDI and Trade liberalization	**2**	**-**	**2**
The rules based measures	**99**	**64**	**35**
IMF index on-off measures (bases IMF's AREAER)	19	16	3
Intensity of the controls IMF index (bases IMF's AREAER)	25	25	-
Other on-off measures based on other than IMF's AREAER	20	4	16
SML policy approach index	34	18	16
Control variable (Henry and Sasson,2008)*	1	1	-

Notes: *is a dummy variable that takes on the value 1 for all members of a country's control group during country liberalization episodes (the liberalization of investing by foreigners on the stock markets).
Source: Author's calculation.

2.4 Capital Account Liberalization patterns and trends in cross-country analysis

This section discusses data availability and provides an analysis of trends and patterns in Capital Account Liberalization using a cross-country analysis. The data sources are presented in Table 1 in Appendix 2.

In practice, there are only a few indicators of Capital Account Liberalization available across a wide cross-section of countries. A natural starting point for this data-based discussion is the selection of the main CAL indicators, which will be representative of the different measures to capture the CAL process.

Table 2.5 presents the list of CAL indicators used in the trend analysis section. Six of them are rules-based measures, such as the SML index, on/off measures: IMF index and Glick *et al*.'s (2004) index, the new measure based on Chinn and Ito's (2008) index

and Intensity measures: Capital Transaction Index and Chinn and Ito's (2008) index. The quantitative measures are represented by three conventional methods to measure the CAL process: International Capital Flows Indexes: Kray and Swan's (1998) index, and Lane and Milesi-Ferretti's (2001, 2003, 2006a) index and Interest rate differentials index: Chanda's (2001, 2005) indicator.

Table 2.5: A summary of CAL Indicators for Restrictions

Name	Source	Description	Range	Years	Country Coverage
Rules-based measures					
On/off measures					
SML index	Various sources- (17) different SML indexes sources	Constructed as on/off indicators of the existence of rules/restrictions that inhibit cross-border flows.	0 (always restricted) to 1 (never restricted)	1980-2006	49 countries
IMF index	IMF's AREAER	Constructed as on/off indicators of the existence of rules/restrictions that inhibit cross-border flows.	0 (always restricted) to 1 (never restricted)	1980-2006	96 countries
Glick *et al*.'s (2004) index	IMF's AREAER	Constructed as on/off indicators of the existence of rules/restrictions that inhibit cross-border flows.	0 (always restricted) to 1 (never restricted)	1998-2006	190 countries
New measure based on Chinn and Ito's (2008) index	IMF's AREAER	Constructed as on/off indicators of the existence of rules/restrictions that inhibit cross-border flows.	0 (always restricted) to 1 (never restricted)	1998-2006	190 countries
Intensity Measures					
Capital Transaction Index	IMF's AREAER	Measures the intensity of capital account restrictions	A range between 0-11.	1998-2006	190 countries
Chinn and Ito's (2008) index	IMF's AREAER	Measures the intensity of capital account restrictions	The higher the value is of this index, the more open a country is.	1970-2009	182 countries
Quantitative measures					
International Capital Flows index					
Kray and Swan's (1998) index	IMF's BoP* International Financial Statistics IMF	Measure based on actual capital flows	Constructed as percentage of GDP	1995-2008	114 countries
Lane and Milesi-Ferretti's(2006) indexes: IFIGDP GEQGDP	Lane and Milesi-Ferretti (2001)	GEQGDP based on accumulated stock of portfolio and direct gross capital flows. IFIGDP based on the stock of direct investment assets (liabilities)	Constructed as percentage of GDP	1970-2003	136 countries
Interest Rate Differentials index					
Chanda's (2001, 2005) indicator	Economic Freedom of the World	Constructed based 4A and 4B where each of the indices has a 50% weight.	A range between 0-10.	1970 - 2006	139 countries

Notes: "Blue" colour represents on/off measures, "Orange" colour represents intensive measures, "Green" colour represents International Capital Flows index and "Yellow" colour represents Interest rate differentials, 'new' measures are in **bold letters** *Source*: IMF's BoP -Balance of Payment Statistics Yearbook , IMF'S AREARE

This section begins with a correlation analysis and a trend analysis of the main CAL indicators. In order to facilitate the analysis a colour coding was adopted. Each colour

represents different category of CAL measures: "blue" is on/off, "orange" is intensive, "green" is International Capital Flows index, and lastly "yellow" represents indices based on interest rate differentials (see Figure 2.1 and Table 2.5).

Correlation Analysis

The correlation analysis suggests a positive relation between almost all the CAL measures presented in Table 2.6, with one principal exception discussed below. This table 2.6 allows to analyse the correlation between each CAL index by looking at column or row. There is a significantly positive correlation between three conventional rule-based measures such as IMF index, Glick Guo Hutchison's index, Chinn and Ito's (2002) index that ranges between 0.707 and 0.807. A positive analogous pattern can be seen with respect to quantitative measures and rule-based measures where the Pearson correlation is between 0.0824 however, this correlation index is significant smaller. There is a strong correlation between categorical measures of quantitative measures (Chanda's index) with rule-based measures compared to other Capital Flow Indexes (between 0.59 and 0.71). The only exception is Kray and Swan's indicator where there is a negative correlation with other CAL measures.

The three new proposed measures are positively correlated with the conventional CAL measures; the lowest value of the Pearson correlation is with Stock Market liberalization indexes (between 0.167-0.446). Especially, a new measure based on Chinn and Ito's (2008) index and the Capital Transaction Index, which are highly corrected with Glick *et al*.'s (2004) index, and Chinn and Ito's (2008) index (between 0.83 and 0.91) (see Table 2.6). This is probably not surprising given the similarity in the underlying methodology.

Table 2.6: Correlation matrix for all main CAL measures

Year	1980-2006	1980-2006	1998-2006	1998-2006	1998-2006	1980-2006	1995-2006	1980-2006	1980-2006	1980-2006
	SML Index	IMF index	Glick Guo Hutchison's index	New measure based on Chinn and Ito's index	Capital Transactions Index	Chinn and Ito's index	Kray and Sway's index	IFIGDP	GEQGDP	Chanda's index
SML Index	1	0.1904*	-0.0194	-0.0384	0.0053	0.3606*	-0.2172*	0.1663*	0.1865*	0.4458*
IMF index	0.1904*	1	0.5396*	0.5283*	0.6188*	0.7074*	-0.0678	0.1834*	0.0824*	0.5967*
Glick Guo Hutchison's index	-0.0194	0.5396*	1	0.8514*	0.9149*	0.8074*	-0.1362*	0.2652*	0.0987	0.6160*
New measure based on Chinn and Ito's index	-0.0384	0.5283*	0.8514*	1	0.8514*	0.8351*	-0.1252*	0.3133*	0.0987	0.6216*
Capital Transactions Index	0.0053	0.6188*	0.9149*	0.8514*	1	0.8401*	-0.1567*	0.2190*	0.1354*	0.6948*
Chinn and Ito's index	0.3606*	0.7074*	0.8074*	0.8351*	0.8401*	1	-0.1443*	0.2738*	0.1147*	0.7193*
Kray and Sway's index	-0.2172*	-0.0678	-0.1362*	-0.1252*	-0.1567*	-0.1443*	1	-0.0094	-0.0164	-0.1403*
IFIGDP	0.1663*	0.1834*	0.2652*	0.3133*	0.2190*	0.2738*	-0.0094	1	0.2553*	0.1144*
GEQGDP	0.1865*	0.0824*	0.0987	0.0987	0.1354*	0.1147*	-0.0164	0.2553*	1	0.1144*
Chanda's index	0.4458*	0.5967*	0.6160*	0.6216*	0.6948*	0.7193*	-0.1403*	0.1144*	0.1144*	1

*Notes:** p<0.1 –statistic significant level. "**Blue**" colour represents on/off measures, "**Orange**" colour represents intensive measures, "**Yellow**" colour represents International Capital Flows index and "Green" colour represents Interest rate, "**Red**" font - new CAL measures. *Source:* IMF's AREAER, IMF's Balance of Payment Statistics Yearbook, IMF's International Financial Statistics, Economic Freedom of the World, Lane and Milesi-Ferretti (2001).

Trend analysis

An analysis of the CAL process pattern across countries clearly distinguishes three waves of the capital account liberalization process that can be defined as: before the 1980s, the 1990s and then the 2000s. This pattern can be seen when considering the IMF index (as detailed in the second row of Table 2.6). The information on the countries liberalising in each wave is given in Table 2.7.

Before 1980, 12% of the country sample had liberalized their capital flows, and these were mainly high-income countries (apart from Oman and Saudi Arabia). A first wave of liberalization indicated that 17% of countries removed their capital control regulation in the beginning 1980; however, 4% of this group stopped the CAL process during the 1980s; these were countries such as Peru, Paraguay, Venezuela, Ecuador[21], Costa Rica, and Mexico. Financial instability in the 1980s resulted in increased capital restrictions for Latin American countries, connected to the debt crisis that began in 1982 with the Mexican weekend. Moreover, the global economy was under pressure because of the US savings and loan crisis of the 1980s.

[21] Ecuador is an interesting case because the country liberalized capital flows for five years between 1980 and 1985, then a similar situation happened from 1988-1992. It can be included in the first wave of liberalization.

It is worth pointing out that the insensitivity of the liberalization process happened in the early 1980s. The second wave started towards the beginning of the 1990s, and included 20 countries (29% of the country population) including some of those who reversed their capital liberalisations during the first wave (Uruguay, Costa Rica, Ecuador, Peru, Venezuela and Paraguay).

Compared to the liberalization process of the 1980s, the CAL process was a little more intensive during the latter part of the 1990s than in the early part of the 1990s. This might have been caused by an increase in European integration (for instance, Poland, Norway, and Greece). On the other hand, other currency-banking crises in the 1990s had noteworthy effects on negative currency fluctuations that had a significant impact on the CAL process in Asia and South America (for instance Malaysia, Indonesia, Guadalupe, Uruguay, and Paraguay).[22] The third wave started at the beginning of the 21st century, which mainly included emerging and developing countries from South America and Africa (see Table 2.7)

[22] European Exchange Rate Mechanism, which suffered a crises during 1992-93, then Asia during 1997-98, the Russian financial crisis was in 1998 and the Brazilian crisis in 2002.

Table 2.7: Different waves in the CAL process based on IMF index

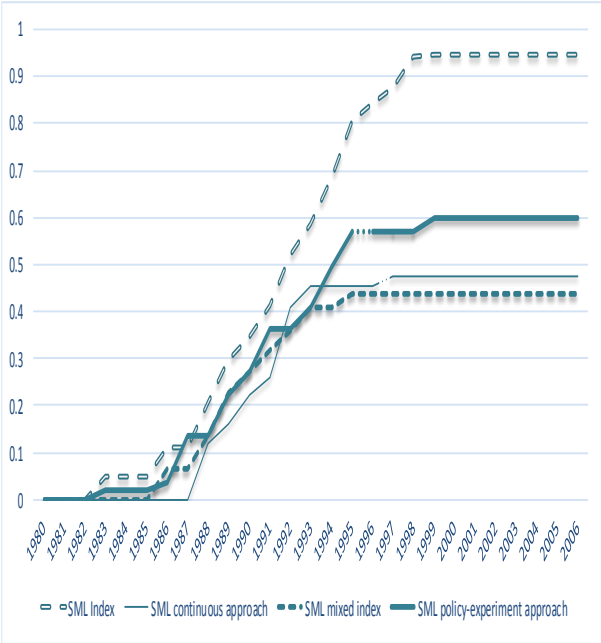
First Wave 1980s	Second Wave 1990s	Third Wave 2000s
Costa Rica (1980-1981)	Argentina (1993-2006)	Chile (2006)
Denmark (1988-2006)	Austria (1993-2006)	Costa Rica (2005-2006)
Ecuador (1980-1985,1988-1992)	Costa Rica (1995-2003)	Guadalupe (2004-2006)
Guadeloupe (1989-1997)	Ecuador(1995-2006)	Haití (2003-2006)
Indonesia (1980-1996)	Spain (1994-2006)	Israel (2002-2006)
Mexico (1980-1981)	Finlandia (1991-2006)	Paraguay (2003-2006)
Malayasia (1980-1996)	France (1990-2006)	Uruguay (2005-2006)
New Zealand (1983-2006)	Gambia (1991-2006)	
Peru (1980-1983)	Greece (1996-2006)	
Paraguay (1982-1983)	Honduras(1993-1995)	
Uruguay (1980-1992)	Ireland(1992-2006)	
Venezuela (1980-1983)	Israel (1996-1997)	
	Italy (1990-2006)	
	Jamaica (1996-2006)	
	Kenya (1996-2006)	
	Mauritius (1996-2006)	
	Niger (1995-2006)	
	Nicaragua (1996-2006)	
	Norway (1995-2006)	
	Peru (1993-2006)	
	Poland (1998-2006)	
	Portugal (1993-2006)	
	Paraguay (1996-1997)	
	El Salvador (1996-2000)	
	Sweden (1993-2006)	
	Uruguay (1996-1997,1999-2003)	
	Venezuela (1996-2006)	
	Zambia(1990-2006)	

Notes: ()-indicates years in which country liberalized capital flow according to IMF index

There were changes through liberalization in the 1980s; however, these on-off CAL indicator trends were stable and a little bit upward. Generally, countries from emerging markets in South America were involved in this process, with some exceptions such as New Zealand and Denmark. On the other hand, the Stock Market Liberalization process was more intensive compared to the CAL process, measured by on/off and intensive measures. Generally, an intensity of SML process happened in the 1990s; however, this process had started between 1982 and 1985. Moreover, the SML frequency analysis confirms that this process happened essentially in the second part of the first wave for the period between 1990 and 1994; this happened for around 50% to 30% of the observations (see Figures 2.2 and 2.3). In Figures 2.3 and 2.4, compared to on/off measures, CAL intensive measures significantly grew at the beginning of the 1990s. This suggests that the CAL process was extremely strong and intensive in the 1990s, not only in the matter of removing main capital control regulations but also by a significant reduction in the number of other capital control regulations.

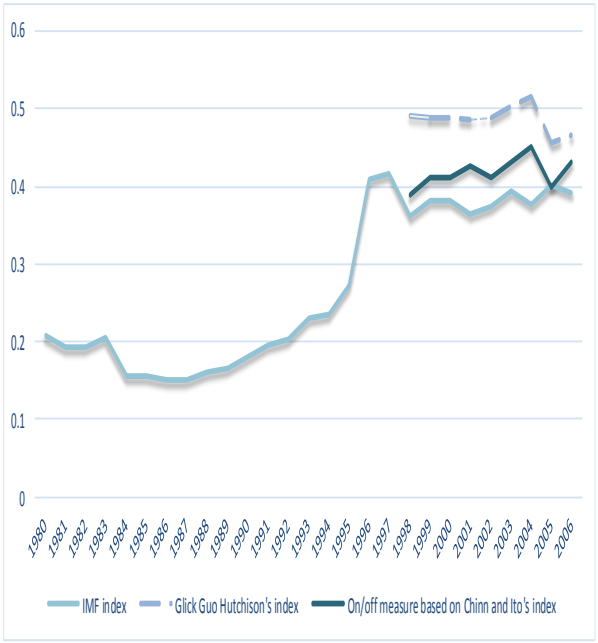
An analysis of the IMF measure and Chinn and Ito's (2008) index (see Figures 2.3 and 2.4), confirmed that the majority of countries only partially implemented capital control. Also the performance and behaviours of a new on/off index is similar to Glick *et al*.'s (2004) index. To be logical, it similar as this new index methodology is based on Glick et al.'s(2004) index. However, a new index is more restricted than other IMF indexes as it controlled for missing values issues. It can explain why the value of this index suggests that countries were less liberalized. Principally, a few countries were considered to be completely open to capital flows (for instance, countries such as Haiti, Vanuatu, and Zambia), suggesting that a majority of the countries are in the middle stages of the CAL process. In other words, they have implemented some of the capital controls and have liberalized other regulations in the sphere of international foreign policy. In addition, newly proposed measures of capital control transactions confirm this process; these have shown that 40% of the observations have a value from 6 to 10, and less than 1% of results were equal to 1 (Figure 2.4 and Table 4 in Appendix 2). However, the new measure of capital transaction index also confirms that the majority of countries had a partial liberalization, but it points out some slight changes in the index before 2000.

Figure 2.2: A comparison between conventional and new CAL measures for 96 countries between 1980 and 2006 (SML indicators)



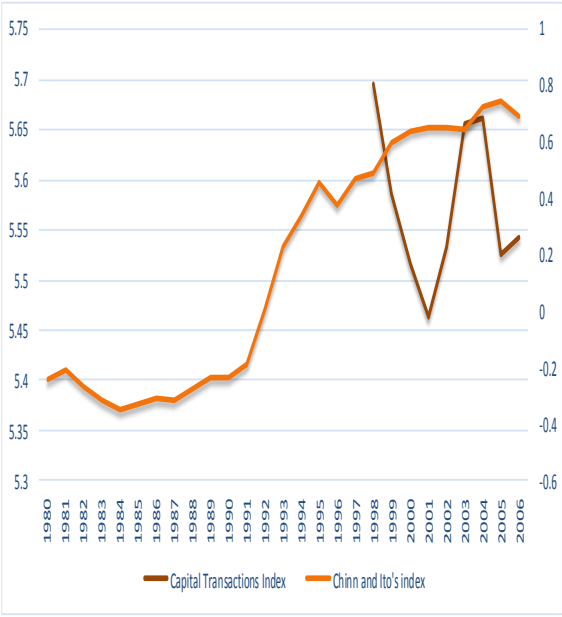
Source: Henry (2000a, b), Henry (2003), Kim and Singal (2000), Patro and Walda (2005), Bekaert and Harvey (2000), Henry and Sasson (2008), Mitton (2006), Bekeart, Campbell and Lundblad (2005) and Chari and Henry (2002a,b)

Figure 2.3: A comparison between conventional and new CAL measures for 96 countries between 1980 and 2006 (On/off measures IMF's AREAER)



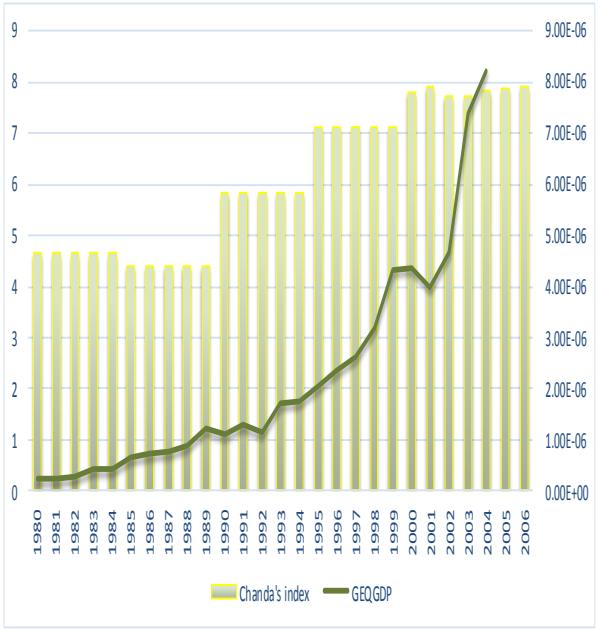
Source: IMF's AREAER

Figure 2.4: A comparison between conventional and new CAL measures for 96 countries between 1980 and 2006 (Intensive measures IMF's AREAER)



Notes: A left axis scale is between 0 and 9 for CAL intensive measures (Capital Transaction's Index- New measure), a right axis scale is between -0.6 and 1.2 for On/Off measures and (Chinn and Ito's index) Source: IMF's AREAER

Figure 2.5: A comparison between different Capital Flows indexes for 96 countries between 1980 and 2006 (Quantitative measures: capital flows and Interest rate differentials)



Notes: A left axis scale is between 0 and 9 for Chanda's index, a right axis scale for GEQGDP index. Source: Economic Freedom of the World IMF's International Financial Statistics, Economic Freedom of the World, Lane and Milesi-Ferretti (2001).

The capital transaction index analysis is similar to the analysis of intensive capital control indexes – Chinn and Ito's (2008) index, which suggested that capital flows indicators on average did not reach half of the maximum value of the index (see Figure 2.4). Also, Interest Rate Differentials index (Chanda's (2005) index) had an upward trend for a period between 1980 and 2006 (see Figure 2.5). In order to simple the analysis, each element of Chanda's index, which are a *black market exchange rates* and *own foreign currency bank accounts*, were not presented in the figures. For instance, a component *black market exchange rate* was closer to full liberalization (almost 10).[23] Then, results for the *own foreign currency bank accounts* component had suggested that a majority of these countries had at least a few regulations of open accounts in any direction, which is visible in 75% of the observations.[24]

Due to the fact that these data were not collected annually between the years 1980 and 2000, it is difficult to draw a single conclusion based on the different CAL waves. However, a significant increase during the first wave is observed, which then shows that the CAL process was continuous and had a steady growth (see Figures 2.3 and 2.4). Both capital flows indexes based on Lane and Milesi-Ferretti's (2001) database showed similar upward trends as the other CAL categorical variables (see Figure 2.5). A majority of changes with capital flow transactions happened as the result of a spur in direct foreign investment. On average, the liabilities side was more affected than changes in the assets side. These results also confirm that by analysing the $IFIGDP_{x,t}$ index as $IFIGDP_{x,t} = (FDIA_{x,t} + FDIL_{x,t}) / GDP_{x,t}$, on average the value of the index was 0.286 for the period between 1980 and 2006. Furthermore, the analysis of Lane and Milesi-Ferretti's (2001) financial globalization indicator ($GEQGDP_{x,t}$)[25] suggested that the majority of the impact was done through direct investments and portfolio investments

[23] Ten is the number of countries without a black-market exchange rate, and those with domestic currency that is fully convertible without restrictions. For freedom to own foreign currency bank accounts that has half of its observations equal to 10 (3D), then for Black market exchange rates 80% of all observations reached 10.

[24] If foreign currency bank accounts are permissible domestically but not abroad or vice versa.

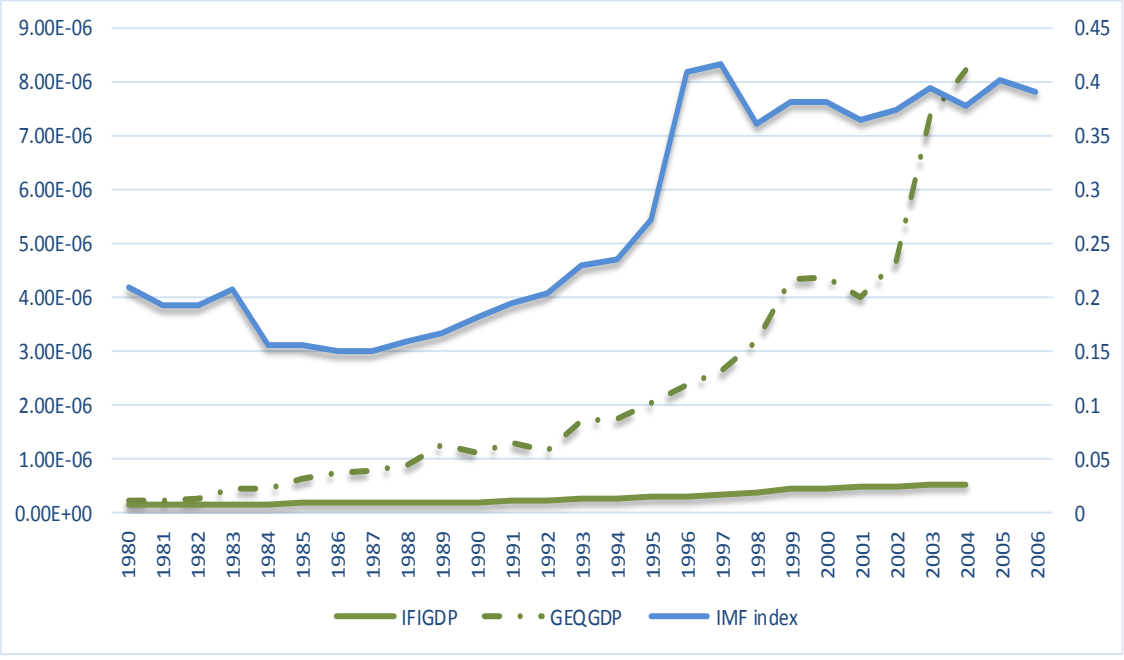
[25] $GEQGDP_{x,t} = (PEQA_{x,t} + FDIA_{x,t} + PEQL_{x,t} + FDIL_{x,t}) / GDP_{x,t}$ where *PEQA* (*PEQL*) denotes the stock of portfolio equity assets and *FDIA* (*FDIL*) denotes the stock of direct investment assets (liabilities).

flows. However, there were significant increases in capital flows that happened in the 1990s and 2000s, not only just in the 1990s as the CAL on/off measures suggested (see Figure 2.5).

The Kray and Sway index is extremely intensively volatile with negative correlation with other CAL indicators. Hence, it can be shown that it is a poor indicator to analyse the patterns of the CAL process. The Kray and Swan (1998) index has suggested that an employment of capital control will affect the capital flows (measures by other on-off indicators based on IMF's AREAER). Figure 2.6 presented the relationship between the main conventional rule-based measure and Lane and Milesi-Ferretti's (2001) capital flow indexes.

It can be seen that the removal of capital control regulation has increased capital flows with respect to Portfolio Investment and any other direct investment indexes as the significant change in the GEQGDP index. Also the second imposition of capital control at the beginning of 2000, which is the beginning of the third wave, seems to have reduced capital flow temporarily (see Figure 2.6).

Figure 2.6: A comparison between Capital Flows and IMF indexes for 96 countries between 1980 and 2006



Source: IMF's Balance of Payment Statistics Yearbook, IMF's International Financial Statistics, IMF's AREAER.

In Table 2.8, the value of the share measure is split into four groups with respect to three waves: completely liberalized (share measure>0.7), liberalized (share measure ≥0.5), partially non-liberalized (share measure <0.5), and non-liberalized (share measure ≤ 0.3) (see Sulimierska, 2008b).

Table 2.8: Share measure calculation for CAL index (IMF index)

Time period Country categories	1980-2006	1st wave 1980-1990	2nd wave 1991-2000	3rd wave 2001-2006
Completely liberalized	(16 countries) 16.6%	(16 countries) 16.6%	(21 countries) 21.9%	(40 counties) 41.6%
Liberalized	(14 countries) 14.5%	(1 counties) 0.01%	(17 counties) 17.7%	(1 country) 0.01%
Partially non-liberalized	(11 countries) 11.5%	(2 countries) 0.02%	(25 countries) 26%	(1 country) 0.01%
Total non-liberalized	(55 countries) 57.4%	(77 countries) 83.37%	(54 countries) 34.4%	(54 countries) 58.38%

Notes: The percentage of a country's population is equal to the ratio between the numbers of countries with a desired value share index divided by the total number of a country's population. The total number of a country's population is 96 for Share measures based on IMF measure (Haiti has missed values over the period from 1998-2002). The value of the share measure allows the countries to be split into four groups: completely liberalized (share measure>0.7), liberalized (share measure ≥0.5), partially non-liberalized (share measure <0.5), non-liberalized (share measure ≤ 0.3). *Source*: Author's calculation based on IMF index

According to the share measure, 12 countries were fully opened during this period.[26] The other four countries, Denmark, Ecuador, New Zealand and Uruguay, obtained share measures above 70%. Thus 68% of countries in the sample were either partially non-liberalized or totally non-liberalized countries (see Table 2.7). Therefore the results from the above confirm the analysis, that a majority of the countries had partially liberalized capital flows.

However, there are some weaknesses in the IMF data, for example, that these measures only consider the existence of administrative controls, moreover, they do not distinguish between restrictions on capital inflows and outflows.

As the preceding discussion shows, measurement methodology has a large impact on understanding and defining the CAL process. Firstly, there are factors that determine

[26] A share measure is equal to 1 for the period between 1980 and 2006. The sample includes the following countries Austria, Belgium, Canada, Switzerland, Germany, UK, Japan, Netherlands, Oman, Saudi Arabia, Singapore and USA.

whether laws controlling capital flows are only on the books or if the regulations are enforced in real economic life, and if it effectively stems from the flow of capital. As discussed in the previous section, the categories of capital flows are imprecise and the implementation of legal regulations based on them can cause different effects from those anticipated by governments. Secondly, market participants may have an incentive to circumvent capital control regulations to maximize their profits. The techniques that are used to avoid capital controls and shift capital across borders (so that they are not detected by government agencies) are similar to tax evasion and money laundering (see Mathieson and Rojas-Suarez, 1992; De Boyrie *et al*., 2001; Forbes, 2007)[27]. Therefore, the different behaviour of the different capital flows indicators, in part is driven by measurement issues, in part because they are capturing different aspects of the CAL process, and partly also by the actions undertaken in order to avoid capital control regulations.

2.5 Conclusion about strengths and weaknesses of existing measures and future implications for a methodology development

In this brief conclusion, two key topics derived from the preceding discussion are summarized: firstly, a description of the main strengths and weaknesses of the different CAL measures, and then secondly, the key findings from the empirical trend analysis.

Strengths and weaknesses of CAL measures

In the financial economics literature, there are numerous measures of capital mobility and control. These measures have been reviewed here with respect to two dimensions: data sources (country and industry perspectives) and with regard to the scope of the analysis (categories of measures). A few conclusions were drawn from the above review with respect to the strengths and weaknesses of CAL measures.

[27] It is worth adding that there are a few empirical studies that have tried to present the problem of avoiding capital control regulations.

Firstly, measurement methodology has a large impact on understanding and defining the CAL process. There are factors that determine whether regulations are limited to the books or enforced in real economic life. As the categories of capital flows are imprecise, so are the legal regulations based on them, which can cause different effects from those anticipated by governments. Also, market participants may have an incentive to circumvent capital control regulations and shift capital across borders in order not to be detected by government agencies. These techniques are similar to tax evasion and money laundering (see Mathieson, Rojas-Suarez, 1992, De Boyrie, et al, 2001 and Forbes, 2007). Secondly, there is a lack of agreement / consistency with regard to the defining binary characters of the rules-based measures, which introduces heterogeneity in their application, and in the conclusions drawn, as well as leading to a potential source of measurement error. This measurement error might also be caused by the gradual nature of the CAL process (see Henry, 2006).

Apart from the gradual character of the CAL process, there is a leaking problem that cannot be observed by policy-makers or researchers. For instance, there are market players, who act before the rules are legislated or leak information to private investors (see Henry, 2000a, b). The other aspect about the rules-based measures is that they only concentrate on the narrowness of stock market liberalisation. These SML measures could be more useful than broad indicators of CAL for testing the economic growth theory (see Henry, 2003, 2006) as they identify episodes of large changes in CAL. However, this creates a narrow focus on stock market liberalization.

In contrast to the unspecified easing of restrictions indicated by movements in the SML indicators, there is no theoretical ambiguity about the expected impact of lifting restrictions on the flow of capital into the stock market of a developing country. However, the SML measures present some weaknesses since investments in shares are linked with a higher risk of using stock market liberalization data to examine the impact of CAL on economic performance.

The other concern is the frequency of the indicators. In the majority of the empirical analyses, indicators are annual. However, stock market data is calculated daily or monthly. This daily or monthly frequency allows a precise analysis of the CAL processes,

especially in the context of pointing out the announcement of dates or leakage problems (see Henry, 2000, 2003, and 2006).

Thirdly, the quantitative measures, built on the assumption of the gradual character of the CAL process, might also be correlated with other factors, such as privatization, macroeconomics, stabilization programmes, etc. (see Lane and Milesi-Ferretti, 2001, 2005; Henry, 2006). This can lead to noise in the data and measurement error, which suggest there is scope for proposeding improved CAL measures. One of the new measures proposed in this chapter is a more disaggregated measure using the IMF's database methodology with the purpose of capturing the variations between sectors or firms, apart from through the stock exchange.

The key findings from the empirical trend analysis

The CAL trends analysis confirmed that the minority of countries seem to be following the partial path of capital flow liberalization. Thus, two-thirds of countries in the sample were either partially liberalized or totally non-liberalized countries. The only exception derives from the analysis of the SML indexes and Chanda's indicator. These two measures suggested that the majority of countries liberalized fully-capital flows with respect to the stock exchange market.

Three waves of the capital account liberalization process were distinguished, and these were before the 1980s, the 1990s and then the 2000s. An exception to this CAL trend is the Kray and Sway (DATE) index, which fluctuates considerably. A first wave of liberalization begins before 1980 when 20% of countries removed capital control regulation. This minor fraction of liberalized countries was caused by financial consequences of the debt crisis that began in 1982 with the Mexican weekend, together with the US savings and loan crisis of the 1980s.

The second wave started at the beginning of the 1990s. It included 23 other countries, plus those that reversed their CAL liberalisation during the first wave (such as Venezuela, Uruguay, Paraguay, Peru, Costa Rica and Ecuador). The other currencies and banking crises in the 1990s had effects on negative currency fluctuations, especially in Latin America and Asia. The third wave, at the beginning of 2000, mainly included emerging and developing countries from South America and Africa.

There are some weaknesses in the on/off measures: these measures only consider the existence of administrative controls and they do not distinguish between restrictions on capital inflows and outflows. The analysis of Lane and Milesi-Ferretti's (DATE) financial globalization indicator demonstrates that there were significant increases in capital flows that happened in the 1990s and 2000s, not only just in the 1990s as the CAL on/off measures advocated. In addition, these capital flow index patterns confirmed that a majority of the impact was done through direct investments and portfolio investments flows, which could serve as evidence of the process of learning how to avoid capital control regulations. In other words, investors learn how to avoid the regulation on capital flows over the years, so when the regulations were imposed a second time in the 1990s, the market participation had knowledge of how to avoid them. It is also important to mention that there was intensive development of financial innovation and technology that gave market participants more ways to transfer money across country borders.

Chapter 3: Economic growth and financial instability as determinants of capital control - cross-country analysis.

Abstract

Over the years a majority of researchers have been interested in what drives and triggers capital control events. As a result of this, a significant number of analyses have been developed, but they are all not extensive studies. Some of these studies have analysed if the crisis of macroeconomic factors and economic growth existences determinate the decisions for the removals of capital control regulations. It has also been suggested and discussed by researchers that there is a significant problem of endogenous characteristic for these factors.

This chapter extends and attempts to understand the mechanism of the determinants, which can cause the Capital Account Liberalization process, for outcomes such as, economic growth, fiscal government policy, macroeconomic and political stability, trade openness, structural and political changes and financial instability. This empirical evidence is taken from a sample of 75-89 countries, observed between 1995 and 2005 showing statistical evidence for trade openness, monetary independence and financial interest rate integration effects. Also, the results obtained suggest that there is no conclusive answer to the impact of economic growth and financial instability on adopting of the CAL process in these countries.

3.1. Introduction

The determinants of the liberalization of restrictions on capital control has been analyzed with respect to several different channels such as, macroeconomics imbalances, political stability, monetary independence, trade and balance of payment openness, strengths of political institutions, and on some occasions it has also been introduced as economic growth and as a financial instability possibility. However, it is important to point out that there is a reverse process which, whereby, capital account liberalization (CAL) can trigger a banking or currency crises (see Edison et al. 2002; Edison, Klein et al. 2001 and 2004).

Also, there are intensive discussions among researchers regarding the efficiency of capital control and the best techniques that can be used to measure the CAL process, to further understand its impact on economic growth. While changes in legal regulations can be written, in practice, these changes may not be implemented. The challenge is to choose a right measure, which aids in identifying an answer to the relationship between the different factors that have an impact on capital control events.

The core aim of this chapter is to investigate, how the CAL process may react to economic growth changes and financial instability. This process can work so that capital control events have an impact on economic growth or vice versa. Considered here are two possible channels.

Firstly, if the liberalization of capital controls can improve allocative efficiency and increase the liquidity of the financial market, this would impact positively on economic growth; however, the opposite is also possible. Leading to the first hypothesis which is, there is a positive relation between economic growth and the CAL process through the allocative efficiency channel.

Secondly, a reduction of capital control can cause a negative effect on financial markets such as, financial fragility and instability, leading to a reduction of economic growth. This process can also happen vice versa, so that the second hypothesis is shows that, financial fragility and instability can lead to the re-imposing of capital controls.

In order to investigate these questions further and test the hypotheses, the cross-country panel was used for the period from 1980 to 2005. The analysis investigated the macroeconomic aspects, before going into sector and firm level analysis in the next chapters 4 and 5.

Therefore, two methods are adopted in order to assess the effect of economic growth, financial instability and CAL. In line with Edwards (2001) and Glick, et al.'s (2004) specifications, the empirical strategy is centred on exploiting the relationship between the effect of capital control reform, economic growth and financial stability.

Firstly, it was employing the Fixed Effect Linear Probability model to show the relationship between capital restrictions and the main determinants of this process. Then secondly, it was using de facto CAL indicators, a Fixed Effect Panel was used to confirm the findings from the descriptive statistics section.

The remainder of this chapter has been structured into four sections. Section 3.2 gives a brief overview of the conceptual framework relating to CAL and economic growth. Section 3.3 describes the empirical strategy and also introduces the datasets and variables used in the empirical model and to delineate the estimation strategy. Section 3.4 presents estimation results that examine the economic growth's impact on the probability, showing that capital liberalization occurs and derives its indirect effect of financial instability on the CAL process. Section 3.5 concludes the chapter and discusses the empirical evidence from the previous sections and links this to the results of other empirical studies.

3.2. Empirical review

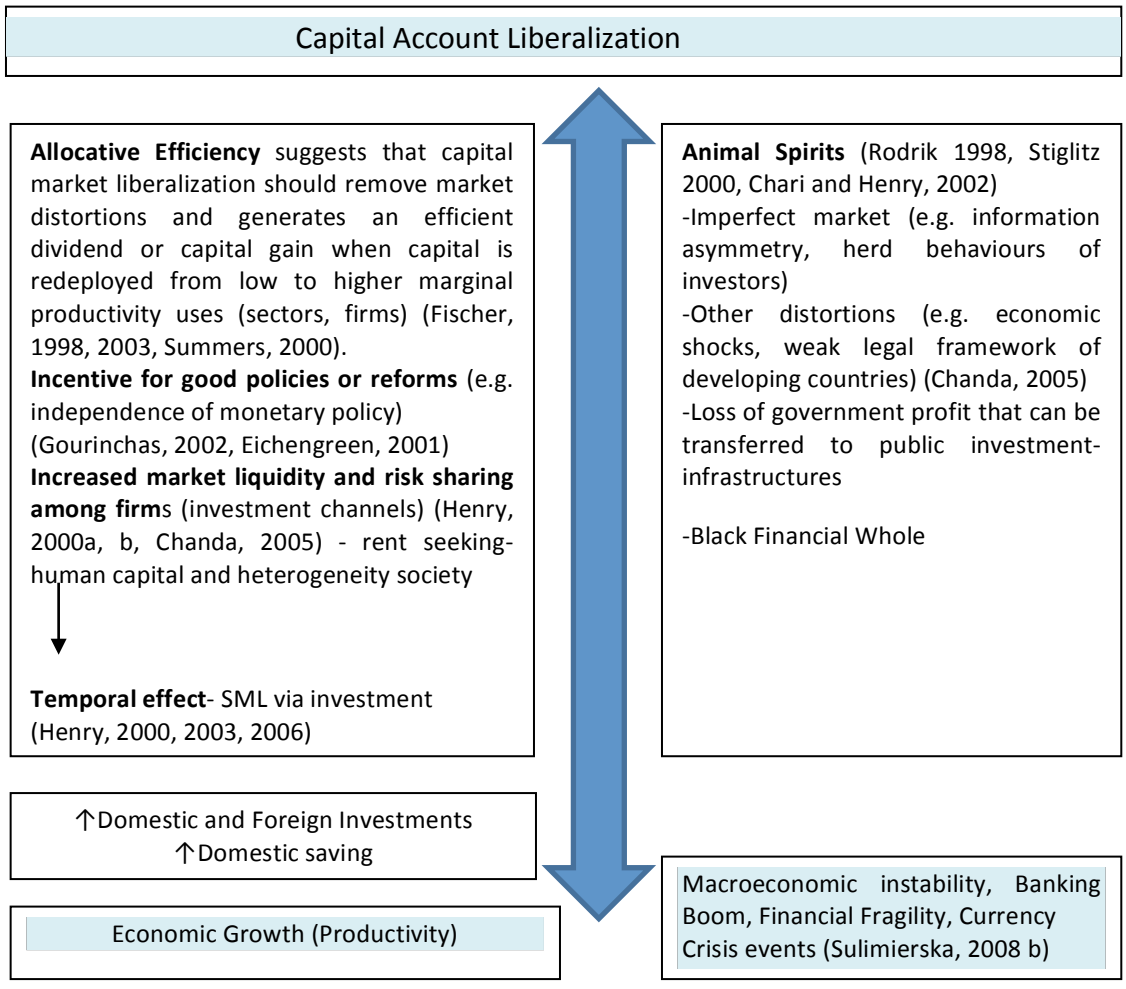
This section discusses briefly the theoretical background of the empirical analysis and summarizes the relevant empirical literature.

3.2.1. A review of the theoretical framework

Several studies have investigated the experience of capital controls and reasons for implementing these controls (e.g. Edison and Reihards 2001 a,b; Edwards 1999; Gregorio

et al. 2000). In all of these studies they point out the mutual causality relationship between economic growths, financial instability and capital liberalization (see below Figure 3.1). In other words, capital controls have an impact on economic development and financial stability these factors have a plausible effect on capital control regulation usage. Further, an intensive theoretical debate regarding liberalization of international capital flows and macroeconomic environments has been presented in the economic and financial literature. Actual experience and reasons that led to the lifting controls, however, tells a different story.

Figure 3.1: The link between CAL and Productivity Growth



Notes: SML- Stock Market Liberalization *Source:* Author's analysis is based on Sulimierska (2008a, b), Rodrik (1998), Stiglitz (2000), Chari and Henry (2002), Henry (2000, 2003, 2006), Eichengreen (2001), Chanda (2005), Fischer (1998, 2003), Summers (2000), Gourinchas (2002).

CAL might cause either direct or indirect, improvements in investment/savings conditions this is leading to an increase of economic growth. Both direct and indirect effects work in the same direction to decrease the cost of capital and increase the efficiency of investment portfolio diversification (see Sulimierska, 2000a, b, Claessens, 1993). This relationship might also have a reverse causality characteristic.

Therefore, this side of the debate suggests that the removal of these distortions allow capital to be redeployed from low to higher marginal productivity uses leading to higher economic growth (Stiglitz and Charlton, 2004, Dollar and Kray 2001, Sulimierska, 2008b).

As with trade liberalization, CAL can be considered as a factor for the 'big push' in which the 'push' involves creating a good environment to move an economy from a low-level equilibrium to a high level equilibrium, through the incentives of good policies and reforms. This provides an incentive for the government to remove regulation in order to provide greater flexibility for capital allocation and then future policies are likely to be more favourable to investments.

Also, Bartolini and Drazen (1997) demonstrated in their model, that a government may use the removal of capital controls to send a signal to investors by removing capital controls. If this signal is successful, capital flows into the country. As the neoclassical theory states, CAL should improve the efficiency of capital investments by removing distortions (e.g. macroeconomic instability, monopolization of the market), and it should work in the same way as the liberalization of the domestic market (an allocative efficiency) (see Summers, 2000, Bartolini and Drazen, 1997).

The removal of these distortions facilitates the redeployment of capital from lower to higher marginal productivity uses. In this way, it is similar to trade liberalization. Capital flows are also similar to trade between time periods (international borrowing and lending) and to the trade between countries (Stiglitz and Charlton, 2004, Dollar and Kray 2001, Sulimierska, 2008b). However, the analysis of the liberalization impact is mainly concentrated on developing and mid-development countries and in this matter it also focuses on the sequence of the CAL process and its coordination with other macroeconomic policies (see Davis, 1996, 1998, 2000) (see Figure 3.1.).

The other side of the debate suggests, that the existence of free capital movement allows for sudden short-term capital outflows, if monetary authorities have lost credibility with investors. This can be caused by macroeconomic and financial instability, leading to decreased economic growth. In this case, capital controls are seen as a course of action in allowing monetary authorities to maintain lower and more stable interest rates. Capital controls are also a method of allowing monetary authorities to retain simultaneous control over interest rate and exchange rate changes (see Edison and Reinhart, 2000) (see Figure 3.1.). However, this is only one part of the story; because this can exist with other causal effects and the increase of economic growth and macroeconomic stability can increase the incentive for monetary authorities to reduce capital control regulations.

However, Alessandia and Qian (2005) have reported, a possibility of macroeconomic instability depended on the strength of financial sector developments. If a country has a strong financial sector, opening up capital account strengthens bank incentives to monitor a firm investment operations, resulting in more investment projects with positive net present value and potential economic growth.

Extant literature is mixed, with respect to the size and direction of CAL impact on economic growth and financial instability and vice versa, but it is clear that this influence has to be analyzed with relation to the two perspectives described above.

3.2.2 Empirical review and conclusion for further analysis of the CAL process

Most empirical studies have reported mixed results on the relationship between capital account integration, economic growth, exchange rate fluctuations and financial stability; Prasad et al. (2003), Klein et al. (2004), Kose et al. (2006) and Moore (2014) have all provided key surveys on this.

There are two primary lines of research: the first group defines the reasons for adaptation of capital controls and its effect on the compositions of capital flows and self-selection incentive to liberalize regulation of capital control, the second line of research analyses the CAL effect on macroeconomic parameters such as, economic growth, financials and exchange rate instabilities.

In the first line of research, several papers have investigated the motives of capital control implementations (see Bartolini and Drazen, 1997, Gregorio et al. 2000, Edwards, 1999, Glick and Hutchison, 2005 and Glick et al. 2006). A majority of these studies found that, capital control policy imposes a signal of inconsistent and poor design of monetary and fiscal policies, which results in future capital flight and instability. For instance, the case studies by Bartolini and Drazen (1997) and Edwards (1999) found that an easing of restrictions on capital outflows often represented early ingredients for a broad set of fiscal and monetary reforms. It is also notable, that weak macroeconomic fundamentals may cause possible problems with respect to the capital account liberalization effect. The removal of capital control regulations can aggravate risk associated with imprudent fiscal policies by providing additional access to external borrowing.

Another issue is the independence of monetary policy and the development of the banking system, which reduces significantly the negative effect of capital account liberalization and possible misallocation of capital. Especially since, Bartolini and Drazen (1997) have pointed out, that lifting of elements of financial repression is an important factor for the changes in restrictions on capital flows. Then, Edwards (1999) investigated the role of capital control regulations for the period prior to the currency crisis. In his research, he showed that, usually counties intensified capital flow controls in the year before the currency collapse. Also, there is a tendency to increase trade barriers to avoid possible balance of payments crisis.

Compared to the previous analyses, Gregorio et al. (2000) and Glick and Hutchison (2005) used econometric techniques to analyze reasons for and the effect of CAL process. Gregorio et al. (2000) employed a VAR model based on Chilean monthly data to investigate the relationship between capital controls, composition of capital flows, interest rates and the real exchange rate, Capital control regulations are measured by Unremunerated Reserve Requirements (URR). They also found, that an increase in interest rate differentials between domestic and international interest rates was caused by imposing URR. Also, an adaptation of URR significantly changed capital flow compositions from short-term flows into long-term flows and vice versa.

Lastly, Glick and Hutchison's (2005) and Glick et al. 's (2006) confirmed Bartolini and Drazen's (1997) result findings, they showed that countries with macroeconomic imbalances, financial weakness, political instability, and institutional problems often decide to hold capital controls with the intention of avoiding capital outflows that may lead to currency crisis. In order to analyse this relationship a Probit Panel Model was used by Glick et al. (2006) with an implementation of property score matching control for the "self-selection" bias.

A 'self-selection' exists, as countries with liberalized capital accounts may also have stronger economic policies and institutions, making them less likely to experience a crisis. It is worth noting, that none of the above mentioned researches investigated the impact of economic growth on the capital account liberalization process.

However, other lines of the research have analysed the impact of capital account liberalization on economic growth, and financial developments. A pioneering paper in CAL literature is by Feldstein and Horioka's (1979), which employed a saving-investment correlation as the CAL process measurement. They analysed the CAL process' impact on causality between the rate of population growth, trade openness and size of the economy, but they did not find conclusive results. Furthermore, the hypothesis of the perfect capital mobility was rejected.

However, this method of analysis was highlighted by Obstfeld (1986 a, b), stating that the facts and data from national income accounts do not yield an accurate representation of the CAL process. For instance, correlation measures between saving and investments might increase, national savings are not precise measures, since ownership shares for domestic firms can be held by foreigners. This fact highlights, how difficult it is to compare data between different countries and with a focus on aggregate data, therefore, the policy-experiment literature does not have enough empirical grounding to be of any use (see Henry 2006).

Grill, Milesi and Ferretti (1993) and Milessi-Ferretti (1998) conducted a study, investigating political determinants of capital control through use of on/off indicators based on the IMF's AREAER. The empirical results, have suggested that capital controls are

more likely to be imposed by strong governments, which have a relatively "free" hand over monetary policy (implying that the central bank is not very independent).

However, this analysis did not find that capital controls affected growth, the hypothesis that capital controls reduce growth was strongly rejected. On the other hand, Montiel (1994) expands on Feldstein and Horioka (1979) and Obstfeld (1986a, b) studies by including measures in addition, other than the saving–investment correlation such as, the gross capital index and then tests for an arbitrage relationship. In his paper, he also shows that, the increase of financial integration is consistent in all these measures.

At the beginning of the 1990s, there were two waves of differing empirical findings. In the first wave, some literature shows that CAL has a negative effect on economic growth (see Levine and Zervos, 1998a, Rodrik, 1998, Eichengreen, 2001, Edison et al. 2002, Stigitz, 2000, Klein (2003), Chanda, 2001, 2005). These researchers employed IMF indicators in cross-time and cross-country analysis. Additionally, these studies also used other intensive CAL indicators and consistently found that CAL had a negative effect on economic growth; Kray (1998) agreed stating that, there is little evidence to show that liberalization of capital flows has a positive impact on economic growth and investment growth by using the capital flow index. Furthermore, Bekaert et al. (2009) also found that financial openness impacts more on productivity growth than on capital growth and that this effect is partially permanent.

In the other wave, studies have suggested that CAL has a positive impact on economic growth (see Edwards, 1997, 2001, Imbs, 2004, Klein and Giovani, 2005, Bekaert et al. 2005). This line of research analyzes the channels between CAL and productivity growth and, found a positive impact through capital accumulation (see Arteta, et al. 2001, Bonfiglioli 2007, Bekaert et al. 2009). Using this line of research, investigations went further than that of previous studies by investigating cross–country sector and firm level data (see Desai et al., 2004, Levchenko et al. 2009); they also found mixed results for the interaction between the CAL process and productivity.

Other gains from liberalization may occur through indirect channels, such as, the decrease of capital cost, improvement of financial debts and impact a financial crisis

prediction, Henry (200b) and Edison and Warnock (2003) found evidence that financial liberalization reduces the cost of capital on stock market exchanges. Also, CAL increased the development of financial markets, as Chinn and Ito (2008) have showed, by using measures of the CAL process through indicators based on IMF's AREAER. Lastly, there is significant empirical literature, which measures the interaction between capital control and currency–banking crisis; these studies show that capital controls have only a little effect on averting currency-financial crises, at least, not without supporting economic policies (Glick et al. 2004 and Sulimierska, 2008).

The extant literature also provides no unique answer, as to whether the CAL process has a positive impact on economic growth and financial instability or vice versa. As this economic process can go in both directions. In this case, it is constitutive to identify that there is an essential gap in economic and financial research on CAL measures that are implemented on a microeconomic level. Furthermore, the analysis of financial liberalization at industry level, instead of country level, might provide greater clarity regarding the ways in which liberalization affects the real economy (see Henry 2006, p.4).

Also, the empirical literature defines other capital control determinants which can be defined into the following groups: trade openness, macroeconomic imbalances, political instability, monetary independence, financial integrations (difference between interest rates) and structural-fiscal imbalance.

3.3 Data and Summary Statistics

This chapter investigates 89 countries between 1995 and 2005. This country sample is larger than Glick et al. (2006) and Glick and Hutchison (2005) however, the analysing period is shorter but it is the same as for sectorial analysis in chapter 5. Glick, Guo and Hutchison (2006) and Glick and Hutchison (2005) analysed the sample of 69 developing countries for period between 1975 and 1997.

The subsequent discussion presented below, is related to each of the variables employed in the empirical analysis. Table 3.1, shows the variables that were used for estimation in

this chapter. The choice of the variables is determined by their availability in the dataset, adopted for this analysis and it is governed by relevance in terms of addressing key interests of the research questions which are based on theory and empirical review discussed in the section 3.2 above. The variables that are employed for the probability and intensity of CAL process analysis is in session 3.5 and their summary statistics are first presented in session 3.3.

3.3.1 Variable for modeling CAL events occurrences

In the empirical models discussed, the variables are divided into three main groups: *control variables*, *relevant independent variable*s: economic growth and financial instability measures and lastly, *dependent variables*: capital control measures.

3.3.1.1 Control variable (x_{xt})

In the estimation of Capital Account Liberalization estimation models, it is commonly recognized that independent control variables are classified into three categories: *macroeconomic, political and economic structure determinants of process***.** The selection of these independent control variables are guided by previous relevant research discussed in section 3.2 above, in order to answers the research questions.

Macroeconomic determinants

Past research has found that an expansion of current account deficits and changes in international interest rates are important for the changes in the Capital Account Liberalization Process (e.g. Eichengreen 2001, Glick Guo and Hutchison 2004, Milessi-Ferretti 1998, Bartolini and Drazen 1997b). They also found that an increase in the Capital Account Liberalization process intensity is positively related to the increase in current account deficits. On the other hand, a higher international interest rate is connected with the relaxation of capital control regulations, as the countries' authorities are less likely to

be worried about the risk of a speculative attack. However, Bartolini and Drazen (1997b) found a different correlation and suggested that, low world interest rates indicate small capital flows, meaning that there is no incentive to remove the regulation of capital controls.

Current account deficits are measured as, the *current account as a percentage of the GDP* (CA_{xt}/GDP_{xt}) in a country x at time t based on IMF's International Financial Statistics database and on the World Development Indicators database. However, there is a significant difference with respect to data availability between these two databases. The World Development Indicators database provides a more complete dataset for this sample of countries over the period between 1995 and 2005.

The literature also finds two main methods for constructing the *level of the real international interest rate* (r^*_{xt}). Glick et al. (2006) and Roubini et al. (1984) constructed the level of the real international interest rate as a proxy of the level for the USA; real long-term interest rate (money market rate) is based on macroeconomic data series from IMF's IFS. The real interest rate is the money market rate or alternatively, the discount rate for the year, minus the ex post CPI inflation rate over the past year, minus percentage change. Then, the other proxy, of the USA's real long-term interest rate was considered as Government Bond Yield, corrected for inflation changes. Therefore, In order to obtain more a complete dataset, the first approach was employed in this analysis.

Thus, the level of the real international interest rate was calculated as:

1) The money market rate is IFS line 60 – Central Bank Policy rate;

2) The discount rate for the year minus the ex post CPI inflation rate over the past year is the difference between IFS line 60 b..zf– Federal funds rate and IFS line 64..xzf CPI% change.

Lastly, it is worth mentioning, that a relation between real domestic and internal interest rate, could be more important than the actual level of the international interest rate. If the international interest rate is equal to the domestic interest rate, there is no incentive for capital movements. In this case, the difference between interest rates is more important and will stimulate capital inflows and outflows. It is also possible that these variables are endogenous if current account deficits have changed or a world interest rate is adjusted in anticipation of liberalization of capital accounts and capital flows. This potential endogeneity issue was partially captured by lagging these macroeconomics factors by one year.

Further, analysis by Glick et al. (2005) and Alessandria and Qian (2005) indicated that, the positive effects of capital account liberalization are limited to countries with relatively well-developed financial systems, good accounting standards, strong creditor rights and the rule of law. Therefore, suggesting that countries, should reach a certain threshold in terms of institutional and economic development before they can expect to benefit from capital account liberalization. In order to investigate this effect, this paper followed the works of Demirguc-Kunt and Levine (2001) and used the private-credit/GDP ratio as an indicator of financial development as drawn from the IMF IFS.[1]

Following Roubini and Sala-i-Martin (1992), financial repression was adopted and is defined as a discrete variable that takes the value 1 when the average of the real interest rate is over the current rate and also for the previous four years this rate was positive, 2 when this rate is negative but higher than 5%, and 3 when it is lower than 5%. The real interest rate is defined as the money market rate or, alternatively, the discount rate for the year, minus the ex post CPI inflation rate over the past year (IFS line 60 or 60b minus the percentage change in line 64). Apart from these measures of financial development, all variables are presented in Table 3.1.

[1] The private-credit/GDP ratio is defined as line 32d divided by line 99b, the financial development variables were implemented into estimation, but there were not statistical significant as the results of this, they were not included in Table 3.1.

Economic structure variables

The other control independent variables that are essential to this empirical analysis are presented here in the literature, Glick et al. (2004), Milessi-Ferretti (1998) and Grilli et al. (1995) found that there is a positive correlation between the increase in the intensity of the capital liberalization process and the relaxation of fiscal policy and trade openness. Furthermore, Bai and Wei (2000) and Milessi-Ferretti (1998) also established that countries with more independent central banks were less likely to use controls, and by the same token, country-individual characteristics include two economic structure variables such as, trade openness (OP_{xt}) and "monetary freedom" index (MF_{xt}) for country x at time t.

In order to obtain precise a measure for trade openness and relaxation of fiscal policy, the approach adopted here, follows Glick et al. (2004). The openness to world trade (OP_{xt}) is measured by the sum of export and import as a percentage of the GDP and this index was taken from the IMF IFS CD-ROM. A relaxation of fiscal policy (G_{xt}/GDP_{xt}) is computed as the relative size of government spending as a percentage of the GDP at market price. This variable was constructed based on information from the United National Common Database and World Development Indicators.

The other economic structure variable, the "monetary freedom" index (MF_{xt}) was taken from the Economic Freedom index, from the Heritage Foundation for the period 1995-2012. The range of the "monetary freedom" index (MF_{xt}) is between 0-100 percent, higher the value of the index; it indicates a more independent monetary policy in the country.

Political explanatory variable

In the literature, Rodrik (1998), Edison et al. (2004) and Klein (2003) pointed out that capital account openness might be intensely impacted by the quality of the government and other political institutional variables. Therefore, a political explanatory variable (PF_{xt}) was incorporated from the Economic Freedom index, from the Heritage Foundation for

the period 1995-2012 as the following: a continuous variable has a range between '0' and '3', where '0' indicates highest level of political freedom, and '3' is full political control. This variable also captures the policy of influence on capital control, in other words political stability is associated with a lower rate of capital control regulation (Eichengreen 2001, Glick, Guo and Hutchison 2005 and Grilli and Milessi-Ferretti 1995).

3.3.1.2 Relevant independent variable

Literature on Capital Account Liberalization events recognizes that there is an endogenous relationship between the level of economic growth, financial instability and the Capital Account Liberalization processes. That is, by asking does CAL drive economic growth and improve financial stability or does economic growth and financial stability drive the removal of capital regulations. Also recent literature highlights the fact that the debate over growth effects of capital account liberalization remains fundamentally unresolved (see Levine and Zervos, 1998a, Rodrik, 1998, Edison, Klein Ricci, Slo, 2002, Stigitz, 2000, Chanda, 2001, 2005) and is discussed in section 3.2. This issue is particularly challenging given the cross-country-time feature of the data is available is limited.

Economic growth variables

Past research has also measured the economic growth variables, as changes in level of GDP PPP is adjusted based on data from World Development Indicators, United Nation Common Database PWT World Bank. The interval in economic growth calculation varies among different researchers from a one-year gap to a 5 year gap (see Rodrick, 1998, Edison, Klein Ricci, Slo, 2002, Quinn and Toyoda 2008). Generally, previous research has analyzed the causality relationship of Capital Account Liberation impacting on economic growth.

This thesis investigates the impact economic growth has on the Capital Account Liberalization decisions making process. An implication is that, countries that experience positive economic growth, have more incentives to remove capital controls. In contrast,

the decline in economic growth, works as a negative signal to reinforce capital control regulations.

Also, compared to previous analysis, economic growth variables are constructed as a dummy variable based on a one-year interval. The benchmark for economic growth is defined as a five percent increase in GDP compared to the previous year. For each country (x)-year (t) in this sample for the period between 1995 and 2005, a binary measurement of economic growth ($GROWTH_{x,t}$) is constructed and defined as "1" - economic growth or, alternatively, "0" - no economic growth. If $(GDP_{x,t} - GDP_{x,t-1})/GDP_{x,t-1} > 5\%$ then $GROWTH_{x,t}$ is equal "1" and vice versa. A five percent growth is interpreted as a significant and substantial growth, which is between rapid growth and temporary growth. Also, this calculation has used the GDP at market prices from the United Nations Common Database.

As it is a cut-off point variable, the sensitivity analysis is used to test different thresholds 2.5% or 3%, and by grouping countries in three different categories; rapid growth country above 5%, medium growth with a rate between 3% and 5% and the slow growth countries with a growth rate below 3%. However, the empirical results were not very different.

Currency and financial crisis indicators

In their literature, Glick et al. (2004), Reinhart et al. (2008) and Eichengreen (2003) found, that an opening of the capital account for the balance of payments, plays was a factor in recent and in past financial crises. There is a large volume of literature on the impact of financial liberalization triggering crises events, but there are no extensive studies, that investigate whether the existences of crisis affects the decision to remove capital control regulations.

In a country with a fragile banking system, which has triggered banking meltdowns, and caused an increase in social-political pressure on the reduction on capital flow liberalization regulations, and in the case of currency crisis episodes, Edwards (1989) and Glick, Guo and Hutchison (2004) found that capital control is intensified in the year prior to the onset of a currency crisis.

In this paper, there are four main financial instability variables ($CRISIS_{xt}$): financial crisis indicator (FC_{xt}), a currency crisis indicator (CC_{xt}), a systematic banking crisis indicator (BC_{xt}) and a debt crisis indictor (DC_{xt}). Each indicator was constructed as a binary measure where '1' means that the crisis happened in a particular year in a country otherwise it is '0'. The crisis indicators are from Honohan and Laeven (2005) and Luc, Laeven Fabian Valendia's (2010) databases, which were updated extending the data to include 2011. This covers systemic banking, debt and currency crisis episodes in the period 1970 –2005. For the period between 2003 and 2005, used are publications from the IMF, World Bank, Moody's and Fitch Ratings, and the Financial Times information used to identify crisis episodes.

3.3.1.3 Dependent variable

In practice, various indicators of capital account restrictions are available across a wide cross-section of countries. As the discussion in Chapter 2 shows, the measures are divided into two main categories, qualitative and rules-based, although there has been some attempt to go beyond and on/off categorization by reflecting the intensity with which controls are imposed, following analyses as Lane and Milesi-Ferretti's (2007), Chinn and Ito (2008).

To capture capital account openness, this chapter has utilized six measures, which represent different features of measures, e.g. on/off features and continuous- intensity features. In order to investigate if a Capital Account Liberalization event happened, binary indicators are employed as an on-off capital transaction index ($imf_{\mathrm{x,t}}$) and the new measure proposed in Chapter 2 is based on Chinn and Ito's (2008) index. These indicators are defined as "1" when liberalization of capital control exists or "0" when the country imposes restrictions on capital control.

An alternative is to use continuous measures of capital account liberalization. These measures assess the intensity of capital controls by the usage of information published in IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) or

by analysing the changes in economic variables such as, capital flows or changes in interest rates etc. The higher the value of measures the more liberalized this country is.

Chinn and Ito (2008) compiled data for 182 countries for the period 1970–2006 based on IMF's AREAER database and created an intensity measure of financial openness. Chinn and Ito's (2008) Intensity indicator ranges from -1.7 to +2.6 and, is focused on four categories for IMF AREAR such as, the existence of multiple exchange rates, requirement to surrender export proceeds, restrictions on current accounts and on capital transactions, which compute the significance of each of them ending up being a continuous variable. To obtain the comparison between intensive rule-based measures, it seems logical to use the new Capital Transaction measure which was proposed in Chapter 2.

Lane and Milesi-Ferretti (2007) established, on the contrary, a measure of capital control as the ratio of external capital stock to GDP. The authors estimated external assets and liabilities for 145 industrial and developing countries using international-investment position figures published by national central banks and governments. Also, Lane and Milesi-Ferretti defined, external assets and liabilities with respect to the type of capital flow. In order for that, the authors determined two indicators as

1) $IFIGDP_{x,t}$ is defined as the sum of foreign direct assets and foreign direct liabilities as a ratio to GDP.

2) $GEOGDP_{x,t}$ is defined as a ratio of the sum of foreign direct assets, foreign direct liabilities, foreign portfolio assets and foreign portfolio liabilities to GDP. The last measure, which acquires fluctuations in capital control regulation as changes in interest rate, is Chanda's index. This index was compiled based on these two indices from the Economic Freedom of the World known as, i) freedom of citizens to own foreign currency bank accounts domestically and abroad and ii) difference between the Official Exchange Rate and the Black Market Rate, the data period used is between 1980 and 2005. Each empirical result for these models is presented as an outcome of benchmark and augmented specification estimations**.** The benchmark equation explains a fact if a country liberalized capital accounts as the result of changes in the set of control variables.

3.3.2 Descriptive Summary Statistics

In this research, the main interest is the relation between CAL, economic growth and financial instability. As described in section 3.2, CAL might have a direct positive effect on economic growth, or vice versa. In this section, we discuss the summary statistics and then present a descriptive analysis on financial crises frequencies, conditional and unconditional on Capital Account Liberalization.

Table 3.1 shows variable definitions, data sources and corresponding summary statistics. The variables that are included in Table 3.1 are the ones, which were used in the actual econometrical estimation. The overall average value of on/off measures of Capital Account Liberalization is approximately 0.4 in the scale between '1' and '0'. In the case of Milsesi-Ferretti's indicators, there are some significant differences with respect to the average and standard deviation, suggesting that there is more volatility if the indicator included the value of portfolio capital flows. The average value of financial instability indicators for liberalized and non-liberalized countries was between 0.08 and 0.01, which meant that a probability of a crisis was even low for period between 1995 and 2005. The average value of the economic growth indicator, on the contrary, shows that one third of country-year observations experienced substantial economic growth periods. Moreover, the table below in the column summarizes the expected sign of coefficients for both estimation equations as described in section 3.3.

Table 3.2 presents the frequencies for on/off measures of the CAL process. Showing, that there is no significant variation over time for the dependent variables. A majority of changes in the CAL process happened as cross-country variations. In this case, it was sensible, to use linear probability estimation with implementation of a yearly fixed effect. To investigate the changes in the capital control process, as there are only a few country switchers with respect to Capital Account Liberalization, We adapted a country-fixed effect in this estimation, which however might not allow for the observation of the impact of liberalization of capital flows, also any variations of a country switcher will be caught by

the country fixed effect as a result of further economic analysis that will include a yearly dummy variable to capture variation over time.

Table 3.1: Variables description and Summary Statistics

Expected sign	Variables	Descriptions	Statistics		
	Control Variables : Macroeconomic variables		Obs	Mean	SD
(+/-)	CA/GDP	Lagged variable of Current Account as percentage of GDP. Source: Trade Sift WDI	979	-1.65	11.11
(+/-)	Interest rate differentials	A difference between real domestics interest rate and international interest rate where domestic interest rate is measures as central bank policy rate (IFS line 60zf) (Units: Percent per Annum Source: International Monetary Fund's CD) and Effective Federal Rate . Source: Federal Reserve System's Data	979	0.39	0.95
(-)	Financial Repression	Range between 1 to 3, 1- average of the real interest rate over the current and previous four year, 2-average of the real interest rate higher than 5% and 3- average of the real interest rates lower than 5%. Source: IMF's IFS	979	1.18	0.57
	Economic structure variables				
(+/-)	G/GDP	Lagged variable of Government consumption as the percentage of GDP. Source: United Nations Common Database and Trade Sift WDI	979	15.58	5.54
(+/-)	OP	Openness to world trade -sum of export and import of goods and services as a percentage of GDP. Source: Trade Sift WDI	979	77.93	48.57
(+)	MF	''Monetary freedom" index with range between 0 and 100. The higher value is linked to higher level of monetary stability with respect to inflation and penalty for inflation. Source: Economic Freedom index from Heritage Foundation	979	72.93	16.43
	Political variable				
(+)	PF	"Corruption freedom" index with range between 0 and 100. The higher value is linked to higher level of corruption based on CPI index. Source: Economic Freedom index from Heritage Foundation	979	44.30	27.13
	Interested independent variable				
(+)	GROWTH	Economic growth indicator is defined as "1" is an economic growth or, alternatively, "0" is no economic growth. If $(GDP_{x,t} - GDP_{x,t-1})/GDP_{x,t-1} > 5\%$ then $GROWTH_{x,t}$ is 1 and vice versa. The calculations used GDP at market prices, national currency, constant prices, (WB estimation) [code: 29916]. Source: United Nations Common Database	979	0.36	0.48
(+/-)	FC	Financial crisis indicator is constructed as a binary measure when '1' means that crisis happened in a particular year in a country otherwise it is '0'. Source: Honohan and Laeven (2005) and Luc, Laeven Fabian Valendia (2010) databases.	979	0.08	0.27
(+/-)	CC	Currency crisis indicator is constructed as a binary measure when '1' means that crisis happened in a particular year in a country otherwise it is '0'. Source: Honohan and Laeven (2005) and Luc, Laeven Fabian Valendia (2010) databases.	979	0.03	0.16
(+/-)	BC	Systematic banking crisis indicator is constructed as a binary measure when '1' means that crisis happened in a particular year in a country otherwise it is '0'. Source: Honohan and Laeven (2005) and Luc, Laeven Fabian Valendia (2010) databases.	979	0.02	0.15
(+/-)	DC	Debt crisis indictor is constructed as a binary measure when '1' means that crisis happened in a particular year in a country otherwise it is '0'. Source: Honohan and Laeven (2005) and Luc, Laeven Fabian Valendia (2010) databases.	979	0.01	0.08
	Dependent variable				
	imf	This indicator is defined as "1" when liberalization of capital control exists or "0" when the country imposes restrictions on capital control. Source: IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)	979	0.43	0.50
	New on/off based on Chinn and Ito's (2008) index	A new measure based on Chinn and Ito's index and Glick *et al.*'s (2004) index. The capital transaction index was computed in a similar way to Glick *et al.*'s (2004) index. This indicators is defined as "1" when liberalization of capital control exists or "0" when the country imposes restrictions on capital control. Source: IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)	712	0.46	0.5
	Chinn and Ito's (2008) Index	This index is computed as the first standardized principal comment of the four categories from IMF's AREAER, such as exchange rate structure, controls on payments for invisible transactions and current transfers, restriction on capital transaction and proceeds from exports and invisible transactions. Source: IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)	712	0.67	1.62
	IFIGDP	This indicator is defined as the sum of foreign direct assets and foreign direct liabilities as a ratio to GDP. Source: External Wealth of National Database - Milsesi-Ferretti (2001, 2003, 2006a)	712	0.43	0.43
	GEOGDP	This is defined as a ratio of the sum of foreign direct assets, foreign direct liabilities, foreign portfolio assets and foreign portfolio liabilities to GDP. Source: External Wealth of National Database - Milsesi-Ferretti (2001, 2003, 2006a)	712	0.68	0.98
	Chanda's index	Constructed based 4A and 4B where each of the indices has a 50% weight. A range between 0-10. Source: Economic Freedom of the World	712	7.67	2.63
	Capital Transaction Index	Sum of subcategories in "*Capital Transaction"* category of IMF's AREAER. Source: IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)	712	5.36	3.52

Note: '+' positive impact on dependent variable, '-'- negative impact on dependent variables, 'new' measures are in **bold letters** which was introduced in Chapter 2

Table 3.2: Frequency of CAL indicators

Year	IMF index		A new CAL index based Chinn and Ito's (2008) index		
	Liberalization	Non-Liberalization	Liberalization	Non-Liberalization	Total
1995	33	56	.	.	89
1996	40	49	.	.	89
1997	39	50	.	.	89
1998	37	52	40	49	89
1999	38	51	41	48	89
2000	38	51	41	48	89
2001	37	52	42	47	89
2002	38	51	41	48	89
2003	39	50	41	48	89
2004	38	51	43	46	89
2005	39	50	37	52	89

Note: Liberalization is a number of country liberalizing capital flow regulations, so on/off indicator is '1' for this year. *Non-Liberalization* is a number of countries that did not liberalize capital flow regulations. *Source:* IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)

3.4. Empirical Methodology

The empirical method employed in this chapter to model the Capital Account Liberalization determinants, exploits Fixed Effect Linear Probability analysis and Fixed Effect Panel. As described in section 3.3.1 estimation variables are divided into three main groups: *control variables*, *relevant independent variable*s: economic growth and financial instability measures and lastly, *explanatory variables*: as capital account liberalization measures for these models. As capital control measures are expressed in two forms, on/off measures and continuous intensive indexes, there are two estimation equations the Fixed Effect Linear Probability model equation and for the Fixed Effect Panel model equation.

To measure the impact of the binary outcome for the CAL variable on interested independent variables, a Fixed Effect Linear Probability model was used with a yearly fixed effect. Then, to analyse an effect of continue CAL measures on economic growth and

financial instability, a Fixed Effect Panel model was employed, as the country-level data is limited for a certain number of countries and it is not a representation for all of the population, therefore for this reason, Fixed Effect models were adopted.

Both econometric estimation results are presented as an augment and as a standard economic growth model with different indicators for capital account openness, but they otherwise use a common set of regressors. However, there are differences in the sample across regression, due to the difference in the set covered by each CAL indicator. But this analysis was drawn from observations of the same time period, 1995 and 2005.

3.4.1. Fixed effect linear probability (FELP) analysis for CAL process

The simplest approach to estimate a binary outcome model is to employ a univariate probability analysis, such as the Linear Probability Model. In the univariate probability analysis, the binary dependent variable (CAL) has two possible outcomes '0' or '1'. In this case, the country that liberalizes capital flows (CAL=1) or does not (CAL=0) in the period in which the data was provided. In a simple Linear Probability Model, it is assumed that there are no unobserved individual effects or time variations.

Under this assumption, standard cross-section models cannot be used to estimate parameters of interest, such as CAL process changes or financial instability implications for cross country and time. Since, the assumption is that there are no unobserved individual effects, it is indeed very restrictive. For the purpose of this analyse this assumption was relaxed, by including individual country effects (C_x) and a time effect (T_t). However, as it was discussed in section 3.3.2, an aggregated time should include information in the time changes as a yearly dummy variable (T_t) as in the model. Also there is a small variation of on/off dependence variables, which suggests, no usage of the country effect (C_x) in the estimations. On the ground, the deterministic Fixed Effect Linear Probability Model is incorporating the types of capital liberalization event variables as discussed previously and is represented as follows (see Greene 2003):

$$Prob(CAL_{xt} = 1\backslash Z_{xt},\ T_t) = \beta_o + \beta_1 Z'_{xt} + T_t + \varepsilon_{it} \quad (3.1)$$

where:

CAL_{xt} is the depend variable and takes the value of '0' for a capital control regulation and '1' for liberalization of capital control in country x at time t. This variable is expressed as on-off capital transaction index ($imf_{x,t}$) *or as* a new measure based on Chinn and Ito's (2008) index as listed in Table 3.1 above.

Z'_{xt} is a vector of independent variables which belongs to three main groups: control variables (X_{xt}) , interested variables related to economic growth and other interest variables, which are represented by different types of financial instability variables as listed in Table 3.1 above.

T_t is dummy variable to observe time effect.

ε_{xt} is random error

However, there are some limitations inherent in the linear probability models, for instance, there are strong exogeneity assumptions that the residuals are uncorrected for all independent variables over the entire time period. Furthermore, the conditional expectation is not bounded between '0' and '1' therefore; the predictions outside this range are meaningless and somewhat embarrassing. The other related problem is that the residual is not normally distributed, though it will be so, if the sample size is sufficiently large, and are inherently heteroskedastic[2] and the t-test is invalid.

A solution to these limitations is provided either by a probit or a logit model. However, in this case, the sample might not be sufficient to convert the maximum likelihood function. In order to address this strong assumption of exogeneity, independent variables were held as lagged variables. Lastly, usage of panel data allows accounting for individual differences, or heterogeneity**.**

[2] A problem with the Linear Probability Model is that, the residual is heteroskedastic; and this can be solved by obtaining estimates of the standard errors that are robust to heteroscedasticity.

3.4.2 Fixed Effect Panel Equation for CAL process estimation

Given the subsequent continue feature of the CAL indicator to measure the intensity of this process in the empirical analysis, which is conducted in the current chapter opts Fixed Effect Panel (FEP). An adaptation of the Fixed Effect Panel helps to capture the intensity of enforcement of the controls on capital account, the current account and actual capital flows cross-country for period between 1995 and 2005. To do this, the following panel model is specified:

$$CAL_{xt} = \beta_o + \beta_1 Z'_{xt} + C_x + T_t + \varepsilon_{xt} \quad (3.2)$$

where

$\mathrm{CAL_{xt}}$ is the depend variable of measure intensity of controls on international transactions in country x at time t. This variable is expressed as Intensity Chinn and Ito's (2008) indicator, Lane and Milesi-Ferretti indicators and Chanda's index as listed in Table 3.1 above.

Z'_{xt} is a vector of independent variables which belongs to three main groups: control variables (X_{xt}) , interested variables related to economic growth and other interest variables which are represented by different types of financial instability as listed in Table 3.1 above.

C_x is an unobserved time invariant individual country effect.

T_t is dummy variable to observe time effect.

ε_{xt} is random error.

This panel model uses cross-section data collected at fixed periods of time generally used as dummy variables for each time period (T_t). This fixed country effect (C_x) approach takes to be a group-specific constant term in the regression model. This term does not vary over time, not that it is no stochastic. The Fixed Effect Panel analysis thus takes into account for any heterogeneity problem and also control for endogeneity problem. The endogeneity problem is the situation, when the random error (ε_{xt}) is

correlated with any of the right-hand side explanatory variables in this model. As a result of this, the estimators of these parameters are biased and inconsistent. This issue is common, as the individual specific error might be fully correlated with explanatory variables. For instance, macroeconomics factors such as the international real interest rate or fiscal relaxation etc. are variables not explicitly included in the CAL equation, and thus the random error encompasses this factor, these macroeconomic characteristic might as well be correlated with monetary stability and independence, country's previous level of government deficit, and political stability. If this is the case, then the random effects estimator is inconsistent and biased. Therefore, by using lagged macroeconomic variables to take account for this potential endogeneity issue.

3.5 Empirical results

This section is divided into two parts, the first part discusses the estimation results of the Fixed Effect Linear Probability Model (FELP), and the impact of different factors on the probability of liberalization of capital control. The second part reports empirical results from the Fixed Effect Panel (FEP) to investigate the changes in a continuous CAL effect, especially the influential factors such as, economic growth and financial instability.

In order to achieve comparative and reliable results with respect to capital control liberalization evenly and the intensity of this process, established is a balance of country panels for 89 countries, to investigate the changes in the CAL process as on/off events and then, adequately a 75 country panel to present the changes in the intensity of this process.

Due to the limitation of data availability for the continue CAL measures, a panel of 89 countries was reduced to 75 countries. In order to clarify the discussion of the empirical results, and color-coding has been adopted in Tables 3.4 and 3.5. Each color represents a different category of the CAL measures, '**blue**' is on/off measures, '**orange**' is intensive measures, '**green**' is International Capital Flow index and lastly, '**yellow**' is Interest rate differentials. This color-coding is consistent with Chapter 2 analysis.

3.5.1. Fixed effect linear probability model (FELP)

Table 3.3 reports the results of the univariate linear probit model with fixed effect as specified in the equation (3.1). This includes are two different indicators of Capital Account Liberalization. Firstly, as discussed in section 3.3.1, the on-off capital transaction index represents the conventional indicator in the value of 0 or 1, which is based on IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAR) report, which we denote as $imf_{x,t}$. Secondly, we used a new measure based on Chinn and Ito's (2008) index, which was developed in Chapter 2. [3]

The benchmark equation is generally estimated in order to study the sample selection problem, and the sample selection bias is connected with the systematic differences between countries that do and do not liberalize capital account, since only countries with a stable economic-political situation are more likely to liberalize capital control. At the same time, these countries are less likely to have a financial crisis, because of good macroeconomic fundamentals.[4]

All regressions were analyzed with inclusion of a yearly fixed effect. Column 2 through 3 of Table 3.3 presents a Capital Account Liberalization Augmented regression model, which is the benchmark liberalization model presented in Column 1, which is in turn, each of the two main on/off measures. Also, the estimation results for each on/off measure, was computed for a different period, due to limited data availability. As of 1998, The IMF have divided Capital Transaction from their Annual Report on Exchange Arrangements and Exchange Restrictions (AREAR) into more sub-categories; therefore, it was not possible to compute a new on/off measure for period between 1995 and 1997.

Hence, in Table 3.3 there are three main parts, the first part represents estimation results for on/off measure over the period 1995 to 2005, then the second part covers the period between 1998 and 2005 and last part includes the empirical results for a new

[3] We have also run regressions similar to the one presented in Table 3.3 when dependent variable was defined as Stock Market Liberalization. The dates of Stock market liberalization was adopted and is therefore analogous in its construction to$imf_{x,t}$. As the sample was only 38 countries, it is not possible to obtain consistence results.

[4] Glick and Hutchison (2004), Eichengreen (2001) and Hendry (2006).

on/off measure. The results in Column 1 generally support the hypothesis that an increase of interest rate differences and more political stability are associated with a higher likelihood of the removal of capital controls that took place earlier. Also, the size and sign of the coefficients for these two control variables are consistent across different periods and different measures.

The finding with regards to political changes in the first specification indicate that the ten point changes in political freedom of index change, increases the probability of a country to liberalize capital regulation by around 0.1 percentage points on average and ceteris paribus. Therefore, the estimation results for political stability are consistent with Grili and Milesi-Ferretti (1995) and Glick, Guo and Hutchison's (2006) findings. The macroeconomic changes of interest rate's impact, on the likelihood of liberalization confirm other studies, where results from Glick, Guo and Hutchison (2006) and Milesi-Ferretti (1998) show this.

An increase of interest rate difference by 1 percentage, increases the likelihood of capital account liberalization by 7 percentage points on average and ceteris paribus. It is interesting, that an increase in difference between interests, causes more incentive for government to reduce capital restriction in order to obtain access to cheaper methods and to finance the deficit. In their paper for instance, a similar logic for opportunity cost was concluded by Bartolini and Drazen (1997b), they found a negative coefficient for the international interest rate variable and suggested that, low world interest rates indicate more capital flows; meaning that there is more incentive to remove regulations of capital.

These test statistics are of significance because they are based on Huber-White's Robust Standard Errors. Columns (2)-(3) of Tables 3.3 report the augmented specification equation which was added to the effect of financial instability and economic growth, to test its impact on liberalization reforms.

The results in Columns 2 and 3, generally do not support the hypothesis that economic growth and financial stability promotes the capital liberalization process. All coefficient signs for interested dependent variables are not statically significant, apart from the coefficient of the currency crisis with respect to a new on/off measure. These results suggest, that an episode crisis in period t has a statistical significant impact, to increase

the probability to impose capital control in period t by 17 percentage points on average and ceteris paribus.

In order to obtain a sensible picture of the economic growth factor, this analysis has used other methods to measure economic growth such as, the continue measure and arbitrage cut-off at level of 2.5% instead of 5%. This analysis also investigates, the importance of lagged interested variables in models; however, the estimation results do not provide any statistically significant support that these interest factors lead governments to impose or remove capital controls.

To sum up, the empirical results model does not provide a supportive and a conclusive outcome to this discussion. Since, the CAL process is more complex, and simple binary variables are less useful to be able to capture the whole effect of economic changes and financial fluctuations. Because, measures of capital controls published by the IMF are rough proxies for controls and do not pick up many nuances in the extent of controls over time and across countries, therefore, in order to capture this complexity of the CAL process it was better to adopt continuous measures.

Table 3.3: Capital Account Liberalization, Economic Growth and Financial Instability-Fixed Effect Linear Probability Model

	IMF Index			IMF Index			New on/off Chinn and Ito's index		
Period	1995-2005			1998-2005			1998-2005		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Currenct Account/GDP (t-1)	-0.00294	-0.00281	-0.00280	-0.00329	-0.00324	-0.00317	-0.00390	-0.00387	-0.00382
	(-1.04)	(-1.00)	(-0.99)	(-1.18)	(-1.17)	(-1.16)	(-1.60)	(-1.60)	(-1.60)
Trade (t)	-0.000996	-0.000931	-0.000940	-0.000968	-0.000934	-0.000907	0.000309	0.000327	0.000336
	(-1.30)	(-1.20)	(-1.20)	(-1.29)	(-1.23)	(-1.19)	(0.44)	(0.47)	(0.48)
Gov.spending/GDP(t-1)	-0.00561	-0.00577	-0.00564	-0.00538	-0.00537	-0.00523	0.00461	0.00462	0.00417
	(-0.73)	(-0.75)	(-0.73)	(-0.64)	(-0.64)	(-0.62)	(0.62)	(0.61)	(0.55)
Monetary independent	0.00211	0.00209	0.00226	0.00162	0.00162	0.00178	0.00197	0.00197	0.00192
	(0.97)	(0.97)	(1.08)	(0.68)	(0.68)	(0.76)	(1.08)	(1.08)	(1.06)
(r-r*) (t-1)	0.0714***	0.0755***	0.0758***	0.0727***	0.0753***	0.0761***	0.0694***	0.0707***	0.0703***
	(9.51)	(9.43)	(9.50)	(9.39)	(8.87)	(8.99)	(10.89)	(10.64)	(10.55)
Political Freedom (t)	0.00983***	0.00973***	0.00973***	0.0102***	0.0101***	0.0101***	0.0102***	0.0101***	0.0101***
	(5.78)	(5.71)	(5.69)	(5.37)	(5.32)	(5.27)	(6.76)	(6.73)	(6.65)
Financial Repression (t)	-0.0847	-0.0878	-0.0854	-0.0775	-0.0795	-0.0754	-0.0928	-0.0938	-0.0962
	(-1.21)	(-1.17)	(-1.13)	(-1.03)	(-1.01)	(-0.96)	(-1.23)	(-1.21)	(-1.22)
Economic Growth(t)		-0.0686	-0.0672		-0.0435	-0.0451		-0.0222	-0.0298
		(-1.72)	(-1.67)		(-1.02)	(-1.06)		(-0.50)	(-0.66)
Financial Crisis(t)			0.0600			0.0763			-0.00383
			(0.65)			(0.68)			(-0.04)
Systemic Banking Crisis(t)			0.0621			0.301			0.104
			(0.66)			(1.63)			(0.57)
Currency Crisis(t)			-0.0259			-0.0678			-0.170*
			(-0.42)			(-0.86)			(-2.00)
Debt Crisis(t)			-0.0284			-0.0817			-0.231
			(-0.17)			(-0.54)			(-1.81)
Year-Fixed Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes
_cons	-0.0232	0.00755	-0.0155	0.102	0.119	0.0902	-0.124	-0.115	-0.0839
	(-0.12)	(0.04)	(-0.08)	(0.55)	(0.63)	(0.50)	(-0.86)	(-0.79)	(-0.58)
N	89	89	89	89	89	89	89	89	89
T	11	11	11	8	8	8	8	8	8
adj. R-sq	0.267	0.270	0.268	0.273	0.274	0.275	0.351	0.350	0.352

Note: Standard errors in parentheses, * - p<0.05, **- p<0.01, ***- p<0.001, *Source:* Database was described in Table 3.1.

3.5.2 Fixed Effect Panel

The regressand in all of the estimates presented in Table 3.4 are from different categories of CAL intensive measures for 75 countries. Each category of CAL indicators represents a different color-coding in Table 3.4. For instance, Chanda's index is a measure of the liberalization process as an integration of interest rates ('yellow'), then a new index measures the intensity of capital regulations ('orange') and another one, focuses on actual capital flows ('green') and the last one, Chinn and Ito's (2008) index measures intensity of based rule regulations with respect to capital transactions and current account ('orange').

A construction of dependent variables as continues measures, allows for investigation further, instead of the change of historical events to move a country from being liberalized or non-liberalized which has occurred as a result of economic or political policy to measure the intensity of the outcome of liberalization. So in order to consider it country specific, we add dummy variables as country effect variables and respectively, yearly dummy variables to control for yearly fixed effect. And in order to capture the endogeneity issue, the lag form of control variables was adopted.

Benchmark equation results in Table 3.4, present the fixed effect panel used to predict the insensitivity of capital account liberalization as a cross various continuous measures of the CAL process. Colum (1) in Table 3.4, shows Capital Account Liberalization Benchmark regression using the same regressors as in previous Fixed Effect Linear Probability model estimations. As in the benchmark specification, reported in column 1 with at least 5% of a significant level, greater trade openness, more monetary freedom and political independence are affiliated with more intensive liberalization, showing that capital-account liberalization is in place. These are the results from previous empirical analysis in this area of research (see Glick, Guo and Hutchison, 2006 and Milesi-Ferretti, 1998). Moreover, the changes in monetary freedom was the main factor which had a strong positive impact on Chanda's index variation, showing that an increase of the

independency of central banks by one unit increases the intensity of capital liberalization by 0.031 on average and ceteris paribus.

Therefore, It seemed logical that there is a strong relation, as one element of monetary policy targeting is used to control the volatility of exchange rate, and at the same time, Chanda's index is constructed based a subcategory of ''difference between the official exchange rate and the black market rate'' which is derived from the Economic Freedom of the World Annual Report. Also, a similar impact of monetary freedom was presented as intensity of the other rule based measure by Chinn and Ito (2008), then, the same effect of monetary freedom variable $(MF_{x,t})$ was shown with respect to other rule-based measures. where Chinn and Ito (2008) indicates a new capital transaction index. These results are consistent with Bai and Wei (2000) and Milesi-Ferretti's (1998) findings.

On the other hand, the degree of political freedom, trade openness and interest rate differential were evidently the main factors to stimulate an intensity of capital account liberalization, which was measured by capital flow movements (see estimation results for Lane and Milesi-Ferretti's indicators in Table 3.4). As, capital flows movements are continuously associated with goods and service movements across borders, an increase of trade openness by one percentage point, associates an increase of capital liberalization by 0.01 on average and ceteris paribus.

The results in Column 1 for capital flows and rule based indicators, support that the changes in the interest rate difference have to be statistically correlated with the capital account liberalization process. For rules-based measures, greater interest rate differences have a positive impact on capital account liberalization. This can be explained as a fiscal incentive, to reduce the cost of financing the government's deficit through lower interest rates abroad. In contract, there is a reverse effect of the coefficient on interest rate differences in Lane and Milesi-Ferretti's indicator (GEQGDP) estimation, hence, it is related to changes in 'hot' capital, where capital is extremely sensitive to interest rate changes and a shift is related to these interest rate changes. As it can been seen, the interest rate changes do not have any statistically significant effects on the capital account

liberalization process which is measured by the other capital flow indicator (IFIGDP) created by Lane and Milesi-Ferretti.

Lane and Milesi-Ferretti's indicator (IFIGDP) is constructed based on the size of the stock of direct investment assets and liabilities, and does not include portfolio investments which are related to 'hot' capital' and any features from the other index by Lane and Milesi-Ferretti (GEQGDP). Lastly, the inclusion of a financial repression variable, on government spending and current account surplus as ratio of GDP has no statistically significant effect on the intensity of capital control, as well as, a likelihood of this process [Column 1 Table 3.4].

Columns (2)-(3) of Tables 3.4, reports the augmented specification with a combination of measures of financial instability and economic growth as explanatory variables, in the Fixed Effect Panel. All coefficient signs for interested dependent variables are not statistically significant across various continues of the CAL measures, with the exception of a currency and systemic banking crises for Lane and Milesi-Ferretti indicators' estimation results. Showing, that an effect of these crises was stronger if the Capital Account Liberalization process was measured by the capital flows index, which was included in the information on portfolio investments (GEQGDP) than in the other Lane and Milesi-Ferretti's index.

These results also confirm other finding by Edwards (1989) and Glick, Guo and Hutchison (2004), that there is no relationship between Capital Account Liberalization and financial instability episodes. We also present regressions, similar to the ones presented in Table 3.4, for the same set of variables over a different period between 1998 and 2005. This period is consistent with a new measure of the Capital Transactions Index, as this measures is based on the Capital Transaction category from the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAR), which was classified into more detailed subcategories. The results similarly to confirm earlier finding for a longer period.

Table 3.4: Intensity of CAL processes, Economic Growth and Financial Instability- Fixed Linear Probability Model

	Chanda's index			Lane and Milesi-Ferretti's indicator (GEQGDP)			Lane and Milesi-Ferretti indicator(IFIGDP)			Chinn and Ito's indicator			Capital Transaction Index (a new index)		
Period	1995-2005			1995-2005			1995-2005			1995-2005			1998-2005		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Currenct Account/GDP (t-1)	0.00378	0.00351	0.00351	-0.00467	-0.00458	-0.00431	-0.00215	-0.00212	-0.00199	0.000747	0.000721	0.000465	-0.00625	-0.00612	-0.00645
	(0.68)	(0.63)	(0.64)	(-1.36)	(-1.35)	(-1.28)	(-1.77)	(-1.76)	(-1.66)	(0.28)	(0.27)	(0.17)	(-0.66)	(-0.64)	(-0.67)
Trade (t)	-0.0103	-0.0109	-0.0125	0.0102***	0.0104***	0.0105***	0.00592***	0.00597***	0.00600***	-0.00270	-0.00276	-0.00227	-0.000658	-0.000293	-0.00114
	(-1.01)	(-1.07)	(-1.20)	(3.57)	(3.57)	(3.61)	(4.40)	(4.39)	(4.31)	(-0.67)	(-0.67)	(-0.55)	(-0.08)	(-0.03)	(-0.13)
Gov.spending/GDP(t-1)	0.113	0.111	0.110	-0.0152	-0.0148	-0.0150	-0.00357	-0.00344	-0.00358	0.000105	-0.0000348	0.000934	0.0305	0.0310	0.0322
	(1.46)	(1.44)	(1.44)	(-1.16)	(-1.16)	(-1.15)	(-0.63)	(-0.61)	(-0.65)	(0.01)	(-0.00)	(0.08)	(1.08)	(1.10)	(1.14)
Monetary independent	0.0312**	0.0309**	0.0348***	-0.00775	-0.00768	-0.00827	-0.00338	-0.00335	-0.00363	0.0157***	0.0156***	0.0157***	0.0352*	0.0354*	0.0411*
	(2.96)	(2.94)	(3.49)	(-1.73)	(-1.73)	(-1.82)	(-1.86)	(-1.86)	(-1.99)	(3.78)	(3.79)	(3.77)	(2.32)	(2.33)	(2.52)
(r-r*) (t-1)	-0.0140	-0.0172	-0.0215	-0.00961*	-0.00859*	-0.00863*	-0.00378	-0.00349	-0.00348	0.0587***	0.0584***	0.0586***	0.150***	0.150***	0.152***
	(-0.54)	(-0.63)	(-0.81)	(-2.18)	(-2.25)	(-2.23)	(-1.84)	(-1.78)	(-1.78)	(5.47)	(5.30)	(5.44)	(8.36)	(8.11)	(8.00)
Political Freedom (t)	0.00527	0.00509	0.00512	0.00484*	0.00490*	0.00491*	0.00207*	0.00209*	0.00208*	0.00670	0.00668	0.00696	0.0185	0.0186	0.0185
	(0.48)	(0.46)	(0.47)	(2.41)	(2.40)	(2.38)	(2.32)	(2.34)	(2.33)	(1.10)	(1.09)	(1.14)	(0.91)	(0.91)	(0.89)
Financial Repression (t)	-0.386	-0.387	-0.373	0.0408	0.0411	0.0400	0.0238	0.0239	0.0234	-0.203	-0.203	-0.208	-0.494	-0.493	-0.503
	(-1.32)	(-1.37)	(-1.33)	(1.14)	(1.16)	(1.11)	(1.17)	(1.17)	(1.15)	(-1.26)	(-1.26)	(-1.23)	(-1.04)	(-1.02)	(-0.99)
Economic Growth(t)		0.109	0.119		-0.0355	-0.0346		-0.0101	-0.00948		0.0108	0.000394		-0.0420	-0.0626
		(1.00)	(1.06)		(-0.93)	(-0.90)		(-0.80)	(-0.74)		(0.24)	(0.01)		(-0.39)	(-0.55)
Financial Crisis(t)			0.593			-0.0478			-0.0246			-0.0793			0.314
			(1.06)			(-0.88)			(-0.93)			(-0.54)			(0.86)
Systemic Banking Crisis(t)			0.197			0.194*			0.0807			-0.0282			-0.173
			(0.50)			(2.27)			(1.93)			(-0.20)			(-0.34)
Currency Crisis(t)			-0.198			0.113*			0.0644*			-0.238			-0.593
			(-0.69)			(2.18)			(2.47)			(-1.38)			(-1.15)
Debt Crisis(t)			-0.273			-0.0165			-0.00266			-0.353			-0.580
			(-0.69)			(-0.24)			(-0.07)			(-1.36)			(-1.58)
Country-Fixed Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year-Fixed Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
_cons	5.960***	5.960***	5.526***	0.809	0.809	0.846	0.401*	0.401*	0.420*	-0.566	-0.566	-0.519	-9.293***	-9.307***	-9.714***
	(3.83)	(3.84)	(3.48)	(1.84)	(1.85)	(1.92)	(2.23)	(2.24)	(2.39)	(-1.29)	(-1.29)	(-1.14)	(-6.37)	(-6.34)	(-6.38)
N	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
T	11	11	11	11	11	11	11	11	11	11	11	11	8	8	8
adj. R-sq	0.826	0.826	0.827	0.883	0.883	0.883	0.903	0.902	0.903	0.907	0.906	0.907	0.908	0.908	0.909

Note: Standard errors in parentheses, * p<0.05, ** p<0.01,*** p<0.00, *Source:* Database was described in Table 3.1.

3.6. Conclusion

The analysis in this chapter provides weak evidence of a statistical significant relation between CAL, financial instability and economic growth episodes.

Both empirical models did not provide empirical evidences of economic growth impacts on the CAL process. Then, the Fixed Effect Linear Probability model estimation results showed that there is a negative effect for currency instability, which can reduce the economic growth effect, which could have an impact on the CAL process. On the other hand, Fixed Effect Panel estimation results based on the capital flow indicator, show that financial instability have a positive impact on the capital account liberalization process with respect to currency crisis and system banking crisis**.** These results are mixed with respect to different ways of measuring the CAL process.

Also estimation results of these two models provided evidences, that other factors have a statistical impact on the CAL process, such as, trade openness, monetary independence and financial interest rate integration effects. This suggests, that the character of the CAL process is related to political decisions, rather than economic ones and provides little evidence of allocative efficiency, as the results of estimation have suggested.

Lastly, it is worth to pointing out, that these results suggest that there is no conclusive answer regarding the impact of economic growth and financial instability on adopting the CAL process in this country. This also suggests, that maybe micro-level analysis might provide a better understanding of this process.

Chapter 4: Total factor productivity estimation for the Polish manufacturing industry- A comparison of alternative methods

Abstract

The concept of total factor productivity (TFP) and its measurement have been of interest to researchers for more than half a century, and are intensively debated topics on economic growth.[1] This chapter discusses problems related to methodologies for estimating TFP at the establishment (sector and firm) levels. These include simultaneity and selection bias, deflated input and output values, and endogeneity of product choice. It then describes existing techniques for overcoming these methodological problems. The empirical analysis was based on data from the manufacturing sector in Poland which has three levels of aggregation for the period 1995 to 2007. The results come from two different techniques: index measures (non-parametric) and parametric production function estimation (OLS), and indicate a significant TFP upward trend over time.

[1] See Edwards (2001), Henry and Sasson (2008), Bonfilioli (2007)

4.1 Introduction

The origins of Total Factor Productivity (TFP) analysis can be traced back to Farrell (1957) and Solow (1957). From a microeconomics perspective, productivity is understood as the fraction of output that is not explained by the amount of inputs used for production (see Comin, 2008). There are three main sources of productivity growth: technical change; allocative efficiency; and changes to the scale of operations.[2] Farrell (1957) defined allocative efficiency as the company's ability to use inputs in their optimal proportions given their respective prices and the production technology available. Technical efficiency has been defined as the firm's ability to obtain the maximal output from a given set of inputs and scale efficiency refers to productive scale size or optimal productive scale (see Coelli, et al., 2005). Significant improvements to data econometrics software that occurred in the mid- 1990s renewed interest in firm-level TFP analysis. Productivity can be measured using parametric or non-parametric methods. Traditional parametric methods for computing TFP which assume a certain shaped production function curve suffer from simultaneity and endogeneity problems.

This chapter provides an empirical overview about the measurement of TFP accounting for input and output choices. Also this chapter aims to obtain more accurate estimates of TFP level for manufacturing sectors by taking account of methodological issues at the establishment level. We discuss and compare the results from two econometric techniques: TFP index measure (non-parametric) and parametric production function estimation (OLS). The Polish manufacturing sector presents an interesting case since it has been under- researched, and also has suffered significant restructuring from 1995 to 2007.

The chapter is organized as follows. Section 4.2 provides an overview of the TFP methodology. Section 4.3 provides a review of the literature on TFP studies in Poland and CEE countries. Section 4.4 discusses the estimation methodology and data used,

[2] See Fare, Grosskopf, Norris, Zhang (1994), Coelli, Rao, O'Donnell, and Battese (2005). The analysis of productivity is strictly connected to efficiency measurements. Efficiency measures estimate the distance of a company or industry from the theoretical optimal at the production frontier.

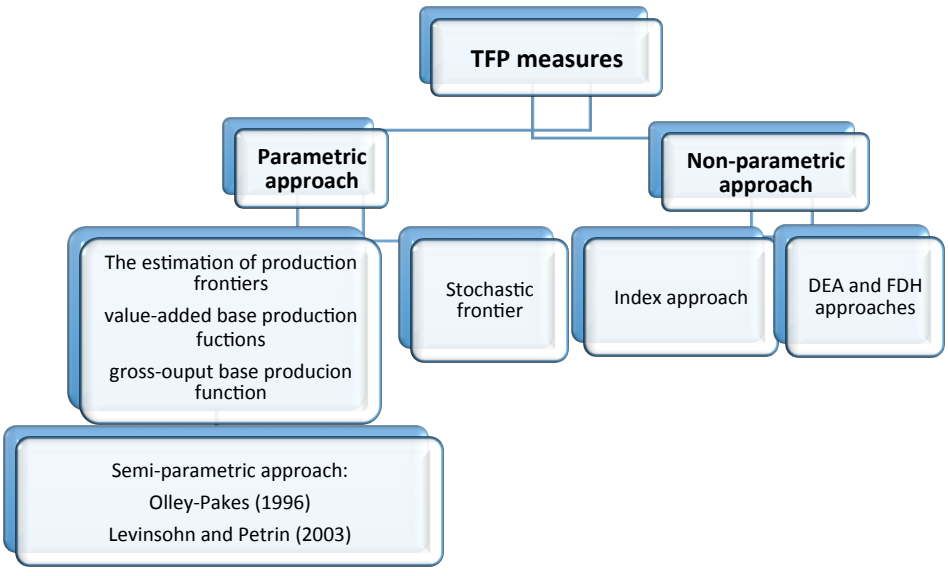
and presents the empirical results for the manufacturing industry. The chapter concludes in Section 4.5

4.2. Productivity measures

Discussions on economic growth highlight factors such as the resources of capital and labour, technical progress, investments in human capital and efficient usage that lead to higher economic performance (see Krugman, 1990 and Stiglitz, 2002). The efficient use of resources and efficient technical processes are contributors to productivity. This section describes the techniques used to measure TFP, the advantages and disadvantages of these techniques and how the measures of output and input impact on TFP measurement.

The literature suggests the use of both parametric and non-parametric approaches (Figure 4.1) to measure productivity. The methods derived from the concepts of maximization of production for a given input and minimization of cost function(s), or maximization of revenue.

Figure 4.1 Measuring Total Factor Productivity Growth



Source: Author's analysis based on Beveren (2007); Coelli et al. (2005), Eberhardt and Helmers (2010), Abramovitz (1990), Simar et al. (2008).

4.2.1 Parametric approaches

The parametric approach estimates the production function by employing two methods: estimation of production frontiers and stochastic frontier approach. This approach defines production as a functional form with the parameters on inputs estimated econometrically using sample data.

Estimation of production frontiers

In order to estimate production frontiers, it is necessary to express a production function with inputs as the explanatory variable and an algebraic function form. A production function is expressed as $y = f(x_1, x_2, \ldots, x_n)$ where output (y) and input (x_i) and i=1, …, n are n-number of inputs. There are many different mathematical forms of the production function as proposed in the literature, such as: Cobb-Douglas, Normalized Quadratic, Constant Elasticity of Substitution (CES), and Generalized Leontief. However, the most common functional form in the applied economics literature is the linear Cobb-Douglas (CD) function.[3] This form is also supported by a standard neo-classical production function $y = f(L, K)$ where L denotes labour and K denotes capital stock. In order to adopt a linear regression framework, the parameter of production function must be in linear form.[4] The Cobb-Douglas function requires the logarithms of both sides of the function. This mathematical transformation yield is the Cobb-Douglas function form as described as:

$$\ln(Y) = \ln(\beta_o) + \sum_{i=1}^{N} \beta_i \ln(x_i) \quad (1)$$

where x_i is expressed as L-labour and K-capital.

[3] See Dowrick, Duc-Tho Nguyen (1989), Abramovitz (1990), Gasiorek, Augier and Varela, (2005), Felipe (1997), Smarzynska (2002), Eberhardt and Helmers (2010), Beveran (2007), Danka-Borsiak (2011).

[4] For instance, the parameters in the linear former form can be estimated using the method of ordinary least squares (OLS), GMM, Generalized Least Squares Method (GLS) (see Gasiorek, et al. 2005; Dowrick, Duc-Tho Nguyen, 1989; Baumol, 1989; Abramovitz, 1990; Smarzynska 2002; Danka-Borsiak, 2011; Glick and Rogoff, 1992 and Edwards, 1998).

The measure of output to estimate productivity can be defined in two ways: as gross output or as gross value-added. For the purpose of simplicity, the reasons in this analysis focuses on the value-added base method. The value-added base production function includes the two parameters labour and capital stock (see Bruno, 1984, Eberhardt and Helmers 2010). The value-added base production function is described as

$$Y = \beta_o K^{\beta_K} L^{\beta_L} \quad (2)$$

where Y is value added, β_o is the Hicksian neutral efficiency level which is unobservable to the researcher,[5] K is the capital stock, L is the labour, β_L is the proportion of labour usage in production and β_K is the proportion of capital usage in production.

In order to obtain the linear estimation equation, a logarithmic transformation must be made thus:

$$\ln(Y_{jt}) = \ln(\beta_o)_{jt} + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) \quad (3)$$

where j – individual unit (e.g. country, firm, industry sector), t =1,.., T - time subscription. Beveren (2007) and Eberhardt and Helmers (2010) discuss output size (Y_{jt}), labour (L_{jt}) and capital stock (K_{jt}). Researchers do not observe the productivity term (w_{jt}) as compared to firm's managers in the following estimating equation,

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) + w_{jt} + \varepsilon_{jt} \quad (4)$$

where $\varepsilon_{jt} + w_{jt} + \alpha_0$ is equal to $\ln \beta_o, \alpha_0$ that measures the mean efficiency level across firms and over time, ε_{jt} identifies measurement error and random noise[6] and w_{jt} is a productivity term (TFP)

Both terms w_{jt} and ε_{jt} are part of the estimation residual. Therefore, to find the value of the TFP parameter it is necessary to estimate the empirical equation (1) to obtain the values of β_L and β_K (respectively $\hat{\beta}_L$ and $\hat{\beta}_K$) and subscript its values as follows:

[5] It can be observed by company managers or company owners.

[6] The estimation results of ε_{jt} will be in the implementation of stochastic frontier.

$$\hat{w}_{jt} = \ln(Y_{jt}) - \hat{\beta}_L \ln(L_{jt}) - \hat{\beta}_K \ln(K_{jt}) \quad (5)$$

Coelli et al. (2005) introduced a discussion of an industry-specific knowledge of technological developments to the broader topic of the transmission bias problem. The transmission bias problem deals with situations when input is not independent of the omitted productivity effect, resulting in bias and inconsistent coefficient estimates $\hat{\beta}_L$ and $\hat{\beta}_K$.

According to Eberhardt and Helmers's (2010) and Beveren's (2007), the transmission bias problem can be developed on the basis of equation (4). If $\ln \beta_o = \varepsilon_{jt} + w_{jt} + \alpha_0$, then the estimation residual is

$$\gamma_{jt} = w_{jt} + \varepsilon_{jt} = w^*_{jt} + \varepsilon_{jt} + \eta_j + \upsilon_t \quad (6)$$

where ε_{jt} is a measurement error and w_{jt} is a productivity term (TFP)

The above description of the production estimation assumes the measurement error to be serially uncorrelated however, the possibility of a correlation between ε_{jt} and the observable inputs (L, K) suggests the presence of a time trend. Therefore, it is necessary to assume common shocks for all firms, and to split the productivity shock w_{jt} into three elements: a common shock for all firms (υ_t), a firm-specific shock (η_j), and w^*_{jt} an actual productivity shock (see Eberhardt and Helmers, 2010).

A common shock across firms (υ_t) includes macroeconomic shocks, or/and overall 'technological progress' which affect all firms and industries. These common shocks and average processes are specified for t=2... T where υ_1=0 implies that α_0 represents average productivity in the base period t=1. On the other hand, the firm-specific elements (η_j) represent the permanent deviation of firm j from the reference firms' average productivity in the base year. Hence, the estimation equation is:

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) + w^*_{jt} + \varepsilon_{jt} + \eta_j + \upsilon_t \quad (7)$$

A transmission bias problem occurs in the moment when the firms decide on their choice of inputs (L, K) based on the realized firm-specific productivity shock (w^*_{jt}). Company managers usually have good market intuition so they can predict the

direction of market trends. Also, managers can directly observe deviations in production that occur in the industry sector in which their companies operate. This adjustment to shocks in firm's policy operations can cause input changes.[7] Thus, they cover both types of productivity shocks: the firm-specific elements and the common shock across firms.

These are observed by firms but not by researchers (see Beveren, 2007). If researchers do not observe these shocks then the effect of inputs K and L on output Y cannot be separated from firm-specific productivity shock (w^*_{jt}). Thus, β_K and β_L are not identified. Even knowing the 'true' population distributions of the data, unbiased and consistent estimates of the input coefficients are not obtainable (see Eberhardt and Helmers, 2010, p. 6). This analysis of firm-specific productivity shocks (w^*_{jt}) suggests that 'transmit' to input choices is a particular problem of 'transmission bias' and does not include productivity. It is strictly linked to aspects such as selection bias (endogeneity of attrition) and endogeneity of input choices (simultaneity bias).[8]

Firstly, there is a selection problem caused by omitting firms' entry or exit over the sample period (see Olley and Pakes, 1996). The probability of firm exit is a function of unobserved productivity (η_j and υ_t) and observed capital stocks (Beveren, 2007). Lower levels of capital and productivity mean a higher probability that firms will be bankrupt in the case of a negative productivity shock. In contrast, firms survive and stay in the market if they have higher productivity and access to higher levels of capital. There are two types of firms: survivors with high capital stocks and losers with small capital stocks. Survivors with high capital and high skills, creating higher profits, have a greater probability to survive compared to losers which are characterized by lower survivor probability (see Beveren, 2007). Selection bias (endogeneity of attrition) causes problematic correlation between ε_{jt} and the observable inputs (K_{jt}) so that the capital coefficient estimate is biased downwards ($\hat{\beta}_K < \beta_K$).

[7] For instance, during a financial crisis times many firm decides to reduce an operation cost though labour redundancies or reduction in investment of fixed assets.

[8] See Olley and Pakes (1996), Beveren (2007), Levinsohn and Petrin (2003), Eberhardt and Helmers (2010).

The second problem is simultaneity bias (endogeneity of inputs) which is caused by a correlation between ε_{jt} and the observable inputs (X_{jt}), if the firms' prior beliefs about ε_{jt} influence its choice of inputs. A traditional OLS estimation method requires independence between the independent variables and the error term.[9] Thus, the results of the OLS estimation in equation (7) are biased through induced endogeneity between labour and the productivity shock. The labour coefficient estimate is biased upwards ($\hat{\beta}_L > \beta_L$) (see Eberhardt and Helmers, 2010, p. 8). However, if the company maximizes profit, a positive productivity shock raises the marginal product of capital and labour with the assumption of constant factor prices. The firm's expansion can cause increased use of inputs which will drive down marginal products.

On the other hand, in the case of a negative productivity shock and unobserved productivity, and since the choice of inputs is likely to be correlated with the residual, the situation is reversed and OLS produces biased estimators ($\hat{\beta}_M > \beta_M$, $\hat{\beta}_K < \beta_K$) (see De Loecker, 2007 and Beveren, 2007). According to Eberhardt and Helmers (2010, p. 8) the sources of transmission bias are related to the attenuation bias. This acts as a downward bias on the factor input coefficients ($\hat{\beta}_L < \beta_L$, $\hat{\beta}_K < \beta_K$). The capital equation is defined as:

$$K_{jt} = K^*_{jt} + \varepsilon_{jt} \quad (8)$$

where K^*_{jt} is the true capital stock and ε_{jt} is a measurement error hence the production function is

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K^*_{jt}) + \zeta_{jt} \quad (9)$$

where ζ_{jt} is a measurement error.

The combination of equations (8) and (9) results in the production function estimation:

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) + (\zeta_{jt} - \beta_K \varepsilon_{jt}) \quad (10)$$

Then, observed capital stock K_{jt} is negatively correlated with the error term in parentheses. If productivity is described as follows:

[9] When X_{jt} is random and is correlated with the random disturbance ε_{jt} then $E(X_{jt}\varepsilon_{jt}) \neq 0$. This makes the moment condition invalid and results in biased estimators (see Hill, Griffiths and Lim, 2007; Wooldridge, 2006)

$$w_{jt} = g(w_{jt-s}) + \zeta_{jt} \quad (11)$$

where g(.) is a function of past productivity and ζ_{jt} is the idiosyncratic productivity shock in period t.

Hence, L_{jt} and K_{jt} are assumed to be endogenous with respect to firm productivity levels, L_{jt} to be predetermined, K_{jt} to be endogenous with respect to ζ_{jt} and the productivity shock ζ_{jt} to be strictly exogenous with respect to the productivity level (see Eberhardt and Helmers, 2010).

Table 4.1 presents a summary of the methodological problems related to parametric TFP estimations in firm-level analysis. Note that these methodological problems have been addressed in productivity analyses at firm level, but not at sector level.

Table 4.1: TFP Estimation and methodological problems

Origin of the bias	Definition	Direction of the bias	References
Selection bias (endogeneity of attrition)	Correlation between ε_{jt} and the observable inputs (K_{jt})	Biased downward ($\hat{\beta}_K < \beta_K$).	Eberhardt & Helmers (2010) Beveren (2007) Olley & Pakes (1996) Wedervang (1965)
Simultaneity bias (endogeneity of inputs)	Correlation between ε_{jt} and the observable inputs (x_{jt}) if firms 's prior beliefs about ε_{jt} influence its choice of inputs	Biased upward/downward $\hat{\beta}_L > \beta_L$ or $\hat{\beta}_L < \beta_L$ Biased upward $\hat{\beta}_M > \beta_M$ Biased downward $\hat{\beta}_K < \beta_K$	Eberhardt & Helmers (2010) Beveren (2007) De Loecker (2007) Levisohn & Melitz (2002)

Note: The other methodological problems are defined with respect to estimation of productivity, such as input price bias and multi-product firms (Beveren 2007, De Locker 2007, Levisohn and Melitz 2002). There are not significant in the sector-level analysis. *Source:* Eberhardt and Helmers (2010) and Beveren (2007).

There are several solutions to endogeneity of input choices and the selection problem related to unobserved productivity. One solution to unobserved heterogeneity and endogeneity problems is the use of fixed effect models. However, Eberhardt and Helmers (2010) suggest that for firm-level data, fixed effects cannot

solve these problems, given the continued existence of a contemporaneous correlation between firm-specific productivity shocks (w^*_{jt}) and the firm's input choices.

Other solutions include instrumentations using input price data (Beveren, 2007, p. 8) or using 'dynamic panel estimators' with efficient 'own instruments'. 'Dynamic panels' were introduced by Arellano and Bond (1991) and Blundell and Bond (1998). The dynamic empirical specification includes lagged terms of the dependent and independent variables and allows computation of the long-run coefficients by considering 'common factor restrictions'. Alternatively, structural estimators can be used to solve these methodological problems. Structural estimators are used by Olley and Pakes (OP) (1996), Levinsohn and Petrin (LP) (2003) and Ackerberg, et al. (2006).

The OP approach is designed to solve endogeneity of attrition and input choice. The endogeneity problem is incorporated into the production function equation through an investment function (I_{jt}). An investment function is used as a proxy for unobserved productivity (w_{jt}). The capital stock function is described as:

$$K_{jt+1} = (1-\delta)K_{jt} + I_{jt} \quad (12)$$

where δ is the depreciation rate and I_{jt} denotes firm j's investment in physical capital at time (t).

In this situation, an investment policy function depends on unobserved productivity and physical capital $I_{jt}(K_{jt}, w_{jt})$.[10] The estimation production function procedure has two steps. The first includes regression of output (Y_{jt}) on labour input (L_{jt}) and nonparametric function of firm-specific productivity ($\phi(K_{jt}, I_{jt})$. Hence the estimation equation is defined as:

$$\ln(Y_{jt}) = \alpha_0 + \beta_L \ln(L_{jt}) + \beta_L \ln(K_{jt}) + \phi_{jt}(I_{jt}, K_{jt}) + \psi_{jt} \quad (13)$$

where ψ_{jt} is an error term.

[10] Conditional on functional form restrictions: the investment function is continuous in K_{jt} and w_{jt}, and provided investment is positive ($I_{jt} > 0$). The inverse function is $w_{jt} = f_t[\ln(I_{jt}), \ln(K_{jt})]$. The $f_{jt}(.)$ takes account of changes in state variables I_{jt}, K_{jt} where labour L_{jt} is assumed to be exogenous with respect to ψ_{jt} is an error term.

Because it is a 'partially -linear' equation, it can be estimated using semi-parametric methods. The proxy for firm-specific productivity is computed as

$$\phi_{jt}[\ln(I_{jt}),\ln(K_{jt})] = \beta_0 + \beta_K \ln(K_{jt}) + f_{jt}[(\ln(I_{jt}),\ln(K_{jt})] \quad (14)$$

Equation (14) represents average productivity level, capital input and inverted investment function proxy for productivity term (w_{jt}). Moreover, $\phi_{jt}(.)$ is approximated by a higher order polynomial in $\ln(I_{jt})$ and $\ln(K_{jt})$.[11]

In the second step, according to Olley and Pakes (1996), it is necessary to consider including the probability of survival of firm j (P_{it}) in the next period t+1. The higher probability of surviving might be linked to higher productivity of firm j. Moreover; firms with higher capital stock will be more likely to survive in the market despite low productivity than companies with smaller capital stock (see Yasar et al., 2008:2). Then, an expectation of productivity shocks based on the previous year's productivity can be defined as:

$$E(w_{jt+1} / w_{jt}, \chi_{it+1}) = g[P_{jt}, \phi_{jt} - \beta_k \ln(K_{jt})] \quad (15)$$

This expected productivity shock is required to calculate the second stage estimation equation such as

$$\ln(Y_{jt+}) - \hat{\beta}_L \ln(L_{jt+1}) = \beta_K \ln(K_{jt+1}) + g\left(\hat{\phi}_{jt}(I_{jt}, K_{jt}) - \beta_K \ln(K_{jt}), \hat{P}_{it}\right) + \varsigma_{it} + \gamma_{jt} \quad (16)$$

where γ_{jt} is the error term, $g(.)$ is approximated by a higher order polynomial in $\hat{\phi}_{jt}(I_{jt}, K_{jt}) - \beta_K \ln(K_{jt})$ and $P_{it} = \Pr\{\chi_{i,t+1} = 1\}$. In order to obtain the correct value for β_K, it is necessary to apply non-linear least squares in equation (16). After obtaining the correct value of the coefficient on different inputs following the procedure in equation (6), it is possible to obtain the value of TFP (see Eberhardt and Helmers, 2010, p. 9).

A second structural estimator was proposed by Levinsohn and Petrin (2003). This structural estimator utilizes intermediate input demand as a proxy for productivity (w_{jt}). The production function is estimated as:

[11] For instance, Arnold (2005) provides examples of 3rd and 4th order polynomials. Yasar et al. (2008) assume 2nd order polynomial series in age, capital and investment.

$$\ln(o_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) + \beta_M \ln(M_{jt}) + w_{jt} + \varepsilon_{jt} \quad (17)$$

where M_{jt} is intermediate inputs, and $\ln(o_{jt})$ gross output is the dependent variable.

The LP is a two-step procedure similar to the OP method instead of an investment function, there is an intermediate inputs function. This intermediate inputs function depends on unobserved productivity and physical capital. The first stage is an estimation of the production function to obtain values for $\hat{\beta}_L$ and $\hat{\xi}_{jt}$ as

$$\ln(o_{jt}) = \beta_L \ln(L_{jt}) + \zeta_{jt}[\ln(K_{jt}), \ln(M_{jt})] + \varepsilon_{jt} \quad (18)$$

$$\zeta_{jt}[\ln(K_{jt}), \ln(M_{jt})] = \beta_0 + \beta_K \ln(K_{jt}) + \beta_L \ln(M_{jt}) + f_t[\ln(K_{jt}), \ln(M_{jt})] \quad (19)$$

where ε_{jt} is an error term.

Similarly, to identify Olley and Pakes's (1996) approach, the second stage of Levinsohn and Petrin's (2003) application is to obtain β_K by estimation equation (19).

$$\ln(o_{jt}) - \hat{\beta}_L \ln(L_{jt}) = \beta_K \ln(K_{jt}) + \beta_M \ln(M_{jt}) + g(\hat{\xi}_{jt-1} - \beta_o - \beta_K \ln(K_{j,t-1}) - \beta_m \ln(M_{jt-1}) + \xi_{jt} + \varepsilon_{jt} (20)$$

With the 'structural estimators' option (see Ackerberg, et al., 2006) there is a problem related to identifying the correct labour coefficient β_L, because labour demand L_{jt} is a function of the proxy for the productivity variable (w_{jt}).[12] The other solution to the endogeneity problem is "structural foundations" to the dynamic panel data estimators proposed by Bond and Söderborn (2006). Since these two estimation techniques cannot be employed in sector-level analysis, they are only briefly discussed here.

Stochastic frontier approach (SFA)

Stochastic frontier is an alternative method for estimating the production frontier and assumes a given functional form for the relationship between inputs and outputs.

[12] In this case investment or the intermediate input functions used to proxy for unobserved productivity have the functional form as $m_{jy} = h_t[w_{jt}, \ln(K_{jt}), \ln(L_{jt})]$.

The analysis of SFA was originated by Aigner and Chu (1968) through the usage of a Cobb-Douglas production function in the firm-level analysis:

$$\ln(Y_j) = \alpha_0 + \sum_{i=1}^{N} \beta_i \ln(x_i) - u_j \quad (21)$$

where j=1,…n (i-th companies), Y_j-the output of the j-th firm, x_i-vector for i-th inputs, u_j-non-negative random variable associated with technical inefficiency.

The concept suggests that the whole production function will be moved down if the firm lacks the ability to obtain maximum output from given inputs (u_j). A negative sign of this random variable suggests a downward shift. Then, the SFA concept expands through the development of symmetric random error (γ_{jt}) as:

$$\ln(Y_j) = \alpha_0 + \sum_{i=1}^{N} \beta_i \ln(x_{ij}) - u_j + \gamma_j \quad (22)$$

where γ_{jt} is statistic noise, u_j is technical inefficiency, j is individual unit (firms), i -1,.. n number of inputs.[13]

Simar (1992) and Hall-Härdle-Simar (1995) adopted this stochastic model in panel analyses through the data generating process. As Schmidt and Lovell (1979) propose, this approach can be implemented in a Cobb-Douglas form with two inputs:

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) - u_{jt} + \gamma_{jt} \quad (23)$$

where γ_{jt}-statistical noise, u_j-technical inefficiency, j – individual unit (firms), i -1,.. n number of inputs, K –capital stock and L- labour.

However as Førsund et al. (1980) and Kumbhaker and Lovell (2000) point out, the main weakness of the SFA is the difficulty to decompose individual residuals in two components (γ_{jt} and u_j) and compute the value of the productivity term. On the other hand, cross-firm data provide a solution because the individual performance of each producer can be traced over a time period sequence which is impossible in a sector-level analysis.

[13] $u_{ji} \geq 0$ and $\gamma_{ji} \in IR$ for all j-individual unit (firms), i =1,.. N number of inputs, $u_{ji} \approx N^{+}(\mu, \sigma_u^2)$, $\gamma_{ji} \approx N(0, \sigma_\gamma^2)$

4.2.2. Non-parametric approaches

The non-parametric approach includes three forms of productivity estimations: Index numbers, Data Envelopment analysis (DEA) and Free Disposability estimators (FDE).

Index approach

The empirical literature of TFP index numbers is much diversified, the aim of this section is to focus on various index numbers in the microeconomics panel analysis (sector- or firm level aggregation). TFP index can be divided into three methods: the Hicks-Moorsteen Index, TFP Index based on the profitability ratio and Malmquist TFP Index.

Firstly, the Hicks-Moorsteen Index is the ratio of output and input growth rates which is another way of computing growth difference. This index follows the formula:

$$TFP_{jt} = {Output\ Quantity\ Index_{jt}}\Big/{Input\ Quantity\ Index_{jt}} \quad (24)$$

where j-th is individual (sector, firm), t is time period

Then, the Hicks-Moorsteen index can be formulated with two types of inputs – capital and labour – in a form of Cobb-Douglas function. This type of index has been used to analyse Polish manufacturing sectors (see Danka-Borsiak, 2011 and Jakubiak, 2002). The productivity determination formula is:

$$TFP_{jt} = \frac{Y_{jt}}{K_{jt}^{\beta_K} L_{jt}^{\beta_L}} \quad (25)$$

where j-th is individual (sector, firm), t is time period, β_K and β_L represents the cost of inputs[14].

These indexes are used to compute technical change and efficiency changes because they contain no information on price changes (see Coelli et al. 2005).

[14] If a firm is minimizing cost, then it will set β_k and β_L as the respective input cost-share. Also the productivity measures might be transformed into logarithmic form and calculated as $\ln(TFP_{i,t}) = \ln(Y_{i,t}) - \beta_{i,t} \ln(L_{i,t}) + (1 - \beta_{i,t}) \ln(K_{i,t})$ where labour share in production $\beta_{i,t}$ is expressed as a ratio of total labour compensations to gross value added, L-labour measures, K-physical capital stock measures under the assumption of a constant returns to scale (see Jakubiak, 2002).

The second approach is the TFP index based on the profitability ratio. The TFP index formula is

$$TFP_t = \frac{(R_t - R_{t-n})/Output\ Price\ Index}{(C_t - C_{t-n})/Input\ Price\ Index} \quad (26)$$

where R_t and R_{t-n} are revenues respectively for two different periods s and t, C_t and C_{t-n} are the costs of s given firms in periods t and t-n.

Lastly, the Malmquist TFP Index is based on computing a distance function.[15] This index is able to include both output-orientated TFI indices and input-orientated TFP indices. This index is constructed to measure the radial distance of the observed output and input vectors in two different periods (s and t), relative to a technology reference. The Malmquist output-orientated TFP indices maximize the level of output to produce goods by using a given input amount and known technology.

The Malmquist input-orientated TFP indices maximizes the level of input to produce goods by using a given output amount and known technology (see Coelli et al, 2005).

The output-orientated Malmquist productivity index is given as:

$$m_0(Q_{t-n}, Q_t, X_{t-n}, X_t) = \left[m_0^{t-n}(Q_{t-n}, Q_t, X_{t-n}, X_t) * m_o^t(Q_{t-n}, Q_t, X_{t-n}, X_t)\right]^{0.5} \quad (27)$$

where quantities are defined respectively t-n and t for Q_{t-n} and Q_t production outputs, then X_t and X_s are inputs for two periods s and t and the prices of inputs are W_t and W_s.

Malmquist input oriented productivity index had similar procedure to be constructed as an output-orientated TFI indices. Malquist input-orientated index can be defined for two periods t-n and t as:

$$m_i(Q_{t-n}, Q_t, X_{t-n}, X_t) = \left[m_i^{t-n}(Q_{t-n}, Q_t, X_{t-n}, X_t) * m_i^t(Q_{t-n}, Q_t, X_{t-n}, X_t)\right]^{0.5} \quad (28)$$

where quantities are defined respectively t-n and t for Q_{t-n} and Q_t as production outputs, then X_t and X_s are inputs for two periods and t and prices of inputs are W_t and W_s.

[15] The distance function is useful to describe the level of technology to measure productivity. This concept was proposed by Malmquist (1953) and Shephard (1953). The distance function allows for a description of a multi-input and multi-output production technology without the need to specify a behavioural objective such as cost-minimization or profit-maximization (Coelli et al, 2005, p. 47).

Malmquist productivity index can be decomposed into two parts which allows measures of efficiency change and technical change. There is an open question about the properties of a return to scale and what Malmquist TFP index captures. For instance, if a constant return to scale is valid then there are two main sources of productivity growth, efficiency change and technical change. On the other hand, Caves, Christensen and Diewert (1982a) do not make any assumptions about the economic scale in relation to the Malmquist TFP index (see Färe, et al., 1994 and Fare, et al., 2006).

There is a large micro-firm-economics literature with regards to a fourth source of productivity growth, that is a multi-output and multi-input firms – output mix effect (OME) and the input mix effect (IME) (see Raa, 2005 and Fare and Primont 2003). However, as it is not part of sector analysis, this research do not go into details. Based on the discussion above, it seems that the Hick-Moorsteen approach is more intuitive than other TFP indexes.

DEA and FDH approaches - a linear programming procedure

DEA and FDH are the other approaches that do not have an assumption about the fixed form of a production function. They are not based on a relationship between factors and outputs.

The DEA approach basic model was introduced by Charnes, et al. (1978). DEA method is commonly used to evaluate the efficiency of a number of producers by comparing each producer with the “best” producers on the market. The “best” producers on the market define an optimal efficient point. Each producer is described as a decision making unit (DMU) in a linear programming procedure for frontier analysis of inputs and outputs. The DEA approach is defined through the following perspectives: input or output orientation, constant or variable returns scale, price information and allocative efficiency, non-discretionary variables and bad or undesirable outputs. The one method to solve a linear programming calculation is to add the convexity constraint (convex cone) with regards to these different perspectives. However, these constraints might not always provide a full description of the real economy (for instance in the case of constant Return to Scale for manufacturing sector).

4.2.3 Summary of weakness and strengths across TFP measures

Several problems and drawbacks might be pointed out in utilizing the parametric approaches to calculate the production frontier. The main problems are linked to statistical problems for a deterministic frontier to predict the correct value of residuals, and the stochastic frontier in its ability to distinguish noise from efficiency (see Simar at el., 2008).[16] Moreover, it is less plausible to be able to use multiple-output or multiple-input situations in the aggregated-sector data analysis. On the other hand, the parametric approach can easily interpret estimation parameters. All non-parametric models capture the distance from the most efficient utilization of inputs to maximization of output or minimization of the cost production that is defined through a distance function section. These approaches do not have an assumption about the fixed form of a production function as such, and moreover they are not based on a relationship between factors and outputs.

However, in order for simple computation, they then have to introduce certain constraints with regards to economy of scale or input or output orientation. In this case, a semi-parametric approach seems to be a solution, which is laid between parametric and nonparametric ways of measuring TFP. This approach enables the control of problems with bias that come out through parametric techniques. The bias problem connects to 'transmit' to input choices, selection bias and an endogeneity of input choices (see Table 4.1).

In order to summarise and compare all different TFP techniques for conducting the empirical analysis, following Coelli, et al. (2005) and Kathuria, et al. (2011), six key parameters are defined in Table 4.2.

[16] A situation of many outliers or too-large residuals ε_j might be problematic in identifying the correct value of productivity.

Table 4.2: Weakness and strengths for different TFP measures

Parameters	Semi-parametric	Parametric		Non-parametric	
		The estimation of production frontier	Stochastic Frontier	Index approach	DEA/FDH
Specification of function Form	Required may be incorrect	Required may in incorrect	Required may in incorrect	Required	Not required
Outliers	Not as sensitive	Not as sensitive	Not as sensitive	Sensitive	Inaccurate efficiency assessment
Sample Size	Moderate sample size is required	Moderate sample size is required	Large sample	Small sample size adequate	Small sample size adequate
Prevalence of high collinearity among inputs	Possible misleading interpretations	Possible misleading interpretations	Possible misleading interpretations	?	Better discrimination
Noise/Measurement errors	?	Affected but less than DEA	Strong distributional assumptions	Sensitive	Highly sensitive
Statistical Testing	Possible	Possible	Possible	Not possible	Possible but complex

Source: Coelli, Rao, O'Donnell, and Battese (2005) and Kathuria, Raj and Sen (2011)

4.2.4. Data issues for productivity analysis

A review of TFP measures suggested that there are three categories of variables required for productivity calculations. These variables are: output quantities, input quantities, and prices of output and inputs. In this section, we will answer to the question: how does a selection of measures of output and inputs impact on TFP measuring?

Starting with output quantities, two different categories are considered; single-output firms and multiple-output firms. This choice is especially important for firm-level analysis. We do not further elaborate on this issue because the analysis of productivity of this thesis is focused on the manufacturing sector and thus, the output is computed at the arrogated level.

However, it is important to choose an appropriate measure of output. One choice is between gross outputs and gross value-added.[17] The empirical literature has argued

[17] Gross output is defined as the sum of the value of outputs of all the firms belonging to the sector. Gross value-added is a measure of the total value of net output of the entire sector outputs that is used as an intermediate input into the sector itself (see Coelli, et al., 2005, p 156).

strongly for using value-added as the measures of production. Diewert (2002) suggests that costs of intermediate input may have significant differences across industries so in this mater it more advisable to use value-added measure for output. Similarly, Hossain and Kaunahara (2004) argue that the use of gross output in the model might diminish the role of capital and labour in productivity growth. On the other hand Norsworthly and Jang (1992) suggests that usage of gross-output as a measure of output might help avoid the problem of distortion of technology, which can be caused by removing the effect of changes in prices of purchased raw-materials inputs from the costs of production. Other researchers are of the same view (see Rao, 1996a, Ray, 2002 and Trivedi, 2004), which indicates that production analysis without investigation of material inputs does not provide the overall picture.

The other issue is to make a proper adjustment from the nominal value aggregate into real value using an appropriate price index. Here there are two methods to be used: single or double deflation methods. Single deflation includes adjustment through output price, while double deflation is related to changes in both output and input prices. As long as the proportion between changes in input and output prices is constant, the results of TFP calculation are the same for both deflation methods. If the input price grows faster than the output price that single deflation calculation of TFP will obtain a downward bias in comparison to double deflation computations (see Coelli, et al. 2005; Kathuria, et al. 2011).

Regarding measurement issues about inputs, input quantities might be classified into two main categories: capital (K) and labour (L).

The most customary methods to measure labour are number of persons employed, number of hours of labour input, number of full-time equivalent employees and the total wages and salaries bill (see Coelli, et al. 2005). Among all these instruments, the number of hours worked is the most accurate measure; however, it is also necessary to take the contracts of employees into account (full-time or part-time employees). For instance, wages and salaries are required for making adjustments for differences in employees' earnings in different firms. Even if these firms are in the same sector, employee benefits might be different because of firm location (i.e. in a capital city or local town). The other measures, such as number of persons employed, face the

problem of constructing a proper measure of full-time and part-time employees in an individual company (see Coelli, et al. 2005, p. 142)[18].

Capital input (K) is the most challenging data to obtain to calculate productivity. The capital input mainly includes three categories; capital stock; capital services and capital cost (see Coelli, et al. 2005). The main problem is how to determine a value of capita stock, measurement of capital services and used costs of capital. There are several methods to measure the value of capital stock, such as the perpetual inventory method (PIM), replacement value, sale price of fixed assets or book value of fixed assets. However each of this measures has its own drawbacks. In the PIM method, if the capital input is given as a measure of total service flows from various capital assets for a given enterprise, then assets are generally seen as fixed assets (such as machinery, equipment) (see Mahadevan, 2003). As Kathuria, et al. (2011) pointed out, perpetual inventory method (PIM) does not address the problem of capacity utilization. Other measures such as replacement value or sale price of fixed assets suffer from a lack of data availability while the book value method may not provide the accurate data of physical stock of machinery and equipment used because of off-balance transaction (e.g. equipment leasing).[19]

4.3. Review of empirical productivity literature for Poland and CEE countries

We now turn to a brief review of work carried out in measuring productivity in Poland in the past two decades. This section focuses especially on the manufacturing sector productivity analysis. Firstly, we review empirical studies which analyse the case of Poland, secondly we investigate the empirical productivity studies for Central Eastern European Countries (CEE) as a whole, which include Poland in their country sample.

This thesis identified 24 papers studying productivity in Poland as a single country that can be group into three categories: productivity analyses of the whole economy, analyses of the manufacturing sector, and analyses at the firm-level.

[18] Still these measures suffer from a limitation in terms of quality of employees: skilled and unskilled workers (see Mahadevan, 2003 and Kathuria et al., 2001).

[19] The majority of data is available in a nominal form; hence it is necessary to calculate a deflator.

All productivity analyses of the whole economy use a parametric approach via the estimation of production frontiers to measure productivity.[20] A majority of these empirical studies focused on examining the effects of the catching-up phenomena, FDI-spill overs, privatization and trade liberalization. These whole economy studies found a positive productivity growth between 1% and 4%. The only exception was Broek and Koln's (2000) empirical study which pointed out negative productivity growth of -0.7% (see Table 4.3). Sector and firm level analyses confirmed the positive trend identified by whole economy analyses in productivity growth.[21] In addition, the results about productivity suggest that the manufacture sectors is more labour intensive than capital intensive since the output elasticity to labour input is between 0.55 and 0.7 (Table 4.3).

On the other hand, the empirical studies at sectorial level compute a productivity growth between 3.6 and 5.5% which is higher than results from the whole-economy analysis (see Table 4.3). Apart from usage of a parametric approach on sector-level analysis (see Dańska-Borsiak, 2011; Kolasa and Żółkiewski, 2004), researchers use other techniques to measure productivity: an index approach (see Jakusiak, 2002, 2006) and partial productivity measures such as a labour productivity (see Woodward, Binkiewicz et al., 2005; Marczewski and Szygieslki, 2005; Barbone et al., 1996; Pawlik, 2006; Bradley and Zaleski, 2003).

[20] Eight empirical studies: Piatkowski (2005), Kolasa and Żółkiewski (2004), Rapacki (2002), De Broek and Koln (2000), Żółkiewski (2003), Welfe (2003), Gradzewicz and Kolasa (2004), Czyżewski (2002)

[21] Nine sector-level studies: Woodward et al. (2005), Marczewski and Szygieslki (2005), Barbone, et al. (1996), Kolasa and Żółkiewski (2004), Jakusiak (2002,2006), Pawlik (2006), Bradley and Zaleski (2003), Dańska-Borsiak (2011), Five firm-level analysis: Marczewski and Szczygieski (2005), Hagemejer (2006), Cullmann and Von Hischhausen (2006), Kotowski and Zagoździński (2005), Pinto, et al. (1993)

Table 4.3: Description of the main empirical studies for Polish productivity

Source	Method of calculation	Period	Output elasticity with respect to labour input	Size	TFP number
Kolasa, Żółkiewski(2004)	Parametric approach-the estimation of production frontier by following Shaikh (1974) and Harrigan's (1997) procedure.	1992-2002	α=0.55 (Gradzewicz,Kolasa, 2004)-GK α= 0.56 (Czyżewski, 2002)-CZ α= 0.7 (Kolasa, Żółkiewski, 2004)-KZ	Whole economy and manufacturing sector (21 sectors)	GK-3.1% CZ-3.4% KZ-3.6%
Rapacki (2002)	Parametric approach-the estimation of production frontier	1992-2002	α= 0.65	Whole economy	4%
De Broek, Koln (2000)	Parametric approach-the estimation of production frontier	1992-1998 1980-1998	α= 0.65	Whole economy	-0.7% -0,49%
Żółkiewski (2003)	Parametric approach-the estimation of production frontier	1991-2001		Whole economy	2,6%
Welfe (2003)	Parametric approach-the estimation of production frontier	1992-1998		Whole economy	1%
Jakubiak (2002,2006)	Non-Parametric approach-TFP index measure	1994-2002	Labour share in production is revenue-based, expressed as a ratio of total labour compensations to value added	Manufacturing (19 sectors)	5,5%
Kolasa (2003)	Parametric approach-the estimation of production frontier	1994-2002		Manufacturing (21 sectors)	66% relative to Germany*
Monnikhof and Van Ark (2002)	Labour productivity: Gross output per person Value Added per Person	1996		Manufacturing	25.4% relative to German productivity*
Piatkowski (2005)	Non-parametric approach index measures Labour productivity	1995-2000	Average share labour compensation in GDP-55,9%	Whole economy	3,97%
Dańska-Borsiak(2011)	Parametric approach-the estimation of production frontier-Dynamic Panel GMM	1998-2007		Manufacturing (22 sectors)	Positive growth

*Notes:**Germany =100. *Source:* Author's analysis based on Kolasa, Żółkiewski (2004), Rapacki (2002), De Broek, Koln (2000), Żółkiewski (2003), Welfe (2003), Jakubiak (2002), Kolasa (2003), Monnikhof and Van Ark (2002), Piatkowski (2005), Dańska-Borsiak (2011)

Similar to the sector-level analysis of productivity, the majority of researchers used partial productivity measures to investigate productivity on the firm-level; however there are some exceptions such as the semi-parametric approach taken by Olley and

Pake (1996), Hagemejer (2006) and the stochastic frontier and DEA analysis offered by Cullmann and Von Hischhausen (2006). It is worth mentioning that the partial productivity measures can lead to misrepresentation of firm and sector performance (see Kathuria, Raj and Sen, 2011). For instance, improvement in labour productivity could be caused by changes in scale economies (see Mahadevan, 2004).

An investigation on the empirical productivity studies for Central Eastern European Countries (CEE) which include in their country sample Poland, reveals this not to be an intensively researched area (13 studies).[22] A majority of the empirical studies employed labour productivity measures and focused on examining the effect of catch-up, trade liberalization and FDI effects.

In sum, this review indicates that there are just few studies investigating productivity in Poland and most of them apply partial productivity measures or the parametric frontier approach.

4.4. Methodology and Data for sectorial level measures analysis

4.4.1 Manufacturing sectorial level data and variable constructions

Manufacturing sectorial level data

Data was obtained from the Statistical Yearbook of Industry from the Polish Central Statistical Office (CSO). According to the Polish Classification of Activities and *NACE rev. 1.1* the industry is divided into main three areas: Mining and quarrying, Manufacturing and Electricity, and Gas and Water supply. Manufacturing alone is divided into 22 sections (Table 1 in Appendix 4.3). This research was conducted between 1995 and 2007. Selecting this period allows for consistency of data as Polish manufacturing data analyses since 1995 have been made to comply with EUROSTAT's *"Nomenclature des Activités de Communauté Européenne –NACE rev. 1.1*" through a decree of the Polish Council of Ministers. Also 2007 was selected because the Polish Statistic Office

[22] Sector level analyses include Monnikhof and van Ark (2002), Van Ark Bart (1999), Havlik (2004), Piatkowski and Van Ark (2004), Stephan (2004). On the other hand, firm-level analysis consider Torlak (2004), Majcen, et al. (2003), Damijan, et al. (2001), Gersl, et al. (2007), Wziatek-Kubiak, et al. (2004), Claessens, et al. (1997), Zukowsa-Gagelmann (2001), Tonini and Jongeneel (2006)

continue to correct and update their data two years after the publication of each study.[23] Furthermore, the Polish Statistic Office changed manufacturing data aggregation in 2008 and it is not possible to merge this data at the sectorial level.

Construction of variables

This analysis requires input quantities and output aggregates to compute TFP as well as definitions for the value of output, capital, intermediate inputs consumption and investments, comparable over time and across industries. The definition of variables and the deflator applied are provided later in this section.

Output

There are essentially three indicators to describe the output in the Polish manufacturing sector at the CSO.

Table 4.4: Description of output variables

Notation	Variable description
Gross output *(GU)*	This variable includes 1) revenues from the sale of self-manufactured products; 2) margins realized on the sale of commodities purchased for re-sale; 3) the value of products in the form of settlements in kind; 4) products designated for increasing the value of own fixed assets; and 5) the changes in inventories of finished goods and work in progress. This variable in expressed in million zlotych (Polish currency).
Gross value added *(GVA)*	This variable is a measure of the net total value of output-mainly a portion of gross output manufactured in industry minus the value of intermediate consumption. This variable in expressed in million zlotych.
Sold production *(S)*	This measure includes products designated for increasing the value of own fixed assets, and the changes in inventories of finished goods and work in progress. Also sold production includes the value of finished products sold (regardless of whether or not payments due were received from them), semi-finished products and parts of own production, the value of paid work and services rendered, lump-sum agent fees in the case of concluding an agreement on commission terms and full agent fees in the case of concluding an agency agreement. This variable in expressed in million zlotych.

Notes: Gross output definition according to CSO is slightly different than commonly understood. As Coelli, Rao, O'Donnell, and Battese (2005, p.156) gross output is defined as the value of the total outputs of all the firms belonging to a particular sector. *Source:* Statistical Yearbook of Industry from Polish Central Statistical Office (CSO) (various years)

[23] However, these corrections can happen for periods even longer than 2 years. Manufacturing data for the period between 1995 and 2005 was available in hard copy which made the corrections more visible.

Even, if there are three different measures of output, it seems show that it is rational to adopt Gross Value Added (*GVA*), given that this measure is the most common in the empirical literature for Poland; which allows us to obtain a possible comparison of the TFP results (see Gradzewicz and Kolasa, 2004; Czyżewski, 2002; Kolasa and Żółkiewski, 2004). In the general literature of TFP, there are supportive voices to use GVA as measure of output (see Diewert, 2002, Hossain and Kaunahara, 2004).

Input quantities

This subsection provides the definitions and explores concerns arising from these definitions about input quantities in the categories of capital (*K*) and labour (*L*). If output is measured as gross value added, then we are going to analyse two types of inputs such as capital and labour.

Capital

The measure of capital input has been widely discussed in the theoretical and empirical literature. As mentioned in subsection 4.2.4, this discussion has not lead to agreement with a correct measure of capital. Most studies in the Polish manufacturing sector do not use the Perpetual Inventory Method (PIM) as the Polish CSO does not provide information on the accumulated depreciation of capital on the manufacturing sector level. Hence, PIM method could not be used in the TFP computation. In this case, inputs of physical capital (*K*) are defined by a gross value of fixed assets (*GVFA*) in thousand zloty. Data for this category is available for the period between 1995 and 2007 for all divisions, sections and sectors.

Labour

According to the Polish CSO, at the sector level this labour measure might be defined in three ways: the average salary of full-time paid employees (*APE*), employment, as of 31 XII (*EM31_)* and average number of employed persons in the industry (*EM*) (see Table 4.5).

Table 4.5: Description of labour indicators

Notation	Variable description
Average salary of full-time paid employees *(APE)*	This measure includes seasonal, temporary and part-time paid employees in terms of full-time paid employees (expressed in thousands)
Employment, as of 31 XII (*EM31_)*	Full-time paid employees (including seasonal and temporary employees) and part-time paid employees in their primary job without converting them into full-time paid employees (expressed in thousands)
An average number of employed persons in the industry (*EM*)	This measures is obtained after converting part-time paid employees to full-time paid employees excluding employers own-account workers and agents (expressed in thousands)

Source: Statistical Yearbook of Industry from the Polish Central Statistical Office (CSO) (various years)

As mentioned in subsection 4.2.4, the number of persons employed (APE) is the most common measure of labour in empirical analyses of productivity. This type of labour measure is also widely used in Polish manufacturing studies (see Dańska-Borsiak, 2011 and Jakubiak 2002, 2006). To obtain TFP results which can be comprisable it was decided to use the average salary of full-time paid employees as the measure of labour.

Price deflator

The CSO's dataset did not provide a consistent measure for input deflator. The common deflator was implemented as price indices of sold production of industry. According to the CSO's database this deflator is classified in line to NACE classification (one-digit, two-digits and three-digits). As Greenstreet (2007) and Eberhardt and Helmers (2010) pointed out, the single deflated price indicator is an inappropriate measure for all parameters such as output, investments and physical capital.[24]

4.4.2. Sector productivity methodology

This methodology describes TFP measures on level. As the results suggest a potential problem of misrepresenting the performance of firms in the manufacturing sector through partial productivity measures, this analysis focuses on TFP measures (see Coelli et al, 2005).

[24] All variables were deflated to 1995 prices level and were expressed in logarithm form for production estimation. For instance, ln (GVA) is expressed as ls. The same rule was applied to other variables.

TFP measures on level

In this chapter, TPF is estimated using parametric and non-parametric approaches. The estimation production frontier is utilized in the parametric method, and the index approach-Hicks-Moorsteen methodology which is the non-parametric approach. These methods were selected, because they seem to be the correct method for estimating Polish manufacturing data, as it does is not have a large number of observations points, and the data is suspect to serious noise caused through the intensive process of economic transformations since 1990.[25] Other parametric approaches such as, stochastic frontier analysis required a large sample, while the other non-parametric approach (DEA) is highly sensitive to noise in the data (see Table 4.2).

In addition, according to the empirical literature review, a majority of the studies for Poland and the CEE countries have used parametric estimation production frontier and the nonparametric-index approach (see Table 4.3). Therefore, for this case, it was rational to compare results from the usage of the productivity measuring method in the literature.

The estimation production frontier

This analysis, applies a parametric estimation of the production frontier to estimate sectoral productivity for the Polish manufacturing sector. This procedure follows Beveren's (2007) study, which estimated productivity as the Cobb-Douglas production function with two inputs, one for labour (L) and one for capital (K), used for value-added base in the equation (32).

The estimation equation is as follows:

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) + w_{jt} + \varepsilon_{jt} \qquad (32)$$

where j – individual industry sectors, t =1,.., T time periods , Y_{jt}-gross value added, L_{jt}-labour will be expressed by three different indicators (*APE*) and K_{jt} is physical capital

[25] Process of privatization, constitutional changes and exchange rate fluctuations.

stock (*GVFA*), α_0- measures the mean efficiency level across sectors and over time , ε_{jt} identifies measurement errors and random noise, w_{jt} a productivity term (TFP).

In order to solve the TFP parameter, it was necessary to estimate the empirical equation (32) to obtain the values of β_L and β_K (respectively $\hat{\beta}_L$ and $\hat{\beta}_K$) and subscripted values:

$$\hat{w}_{jt} = \ln(Y_{jt}) - \hat{\beta}_L \ln(L_{jt}) - \hat{\beta}_K \ln(K_{jt}) \quad (33)$$

Index approach

The index approach, used the Hicks-Moorsteen Index, with two factors (labour and capital) to compute TFP in the Polish manufacturing sector (see Jakubiak, 2002, 2006). We also decided to follow this index's methodology to compare results with the parametric analysis.

The Hicks-Moorsteen Index for capital (K) and labour (L) is expressed in a "natural' logarithmic form (see Jakubiak, 2002, 2006) as

$$\ln(TFP_{j,t}) = \ln\left(Y_{j,t}\right) - \beta_K \ln\left(K_{j,t}\right) - \beta_L \ln\left(L_{j,t}\right) \quad (34)$$

where t-time periods, j –sector unites β_K and β_L are taken directly from observed data based on input's cost-share, K_t is gross value of fixed assets (*GVFA*) and output Y_t is a gross value added (*GVA*) and L_t - number of employees (*APE*).

Following Jakubiak's methodology, with the assumption of constant return to scale, ($\beta_K + \beta_L = 1$) where β_L is defined as a labour share in production with revenue-base expressed as a ratio of total labour compensations to gross value added and $\beta_K = 1 - \beta_L$.

To summarise, the parametric approach and the nonparametric-index approach are estimated on three different data aggregation levels. The variables and their measures were previously described in Section 4.4.1.

4.5. Empirical productivity results for sector level analysis

The analysis of TFP is presented on three different data aggregations; calculating TFP for Total Manufacturing (NACE one-digit classification)[26], the three main divisions of Manufacturing (NACE two-digit classification) and as the 22 manufacturing sectors (NACE three-digit classification) (see Table 1 in Appendix 4.3).

The empirical results of the TFP trend are presented as two main parts. Firstly, the analysis of TFP for Total Manufacturing (NACE one-digit classification) and its three divisions, and secondly, the analysis of the 22 manufacturing sectors. Estimations for Total Manufacturing and each of the three divisions have a cross-time character for the period between 1995 and 2007. The TFP estimation for the 22 manufacturing sectors is a two-dimensional panel analysis (time and sectors).

4.5.1 Empirical productivity results for Total Manufacturing and its divisions.

The time-series for total manufacturing considers the period between 1995 and 2007 and summary statistics are presented in Appendix 4.4 in Table 1. As data availability was limited, it was not possible to implement a more complex methods to measure productivity, such as stochastic frontier and econometric techniques. Thus, to compute TFP, this analysis has applied a parametric approach to compute the production frontier on value-added base (OLS) and a non-parametric Hicks-Moorsteen Index. The results of the parametric approach showed us that the coefficients for capital and labour were not statistically significant and thus, there was no reason to compute TFP parametric measures and it was decided to only concentrate on TFP index measures.

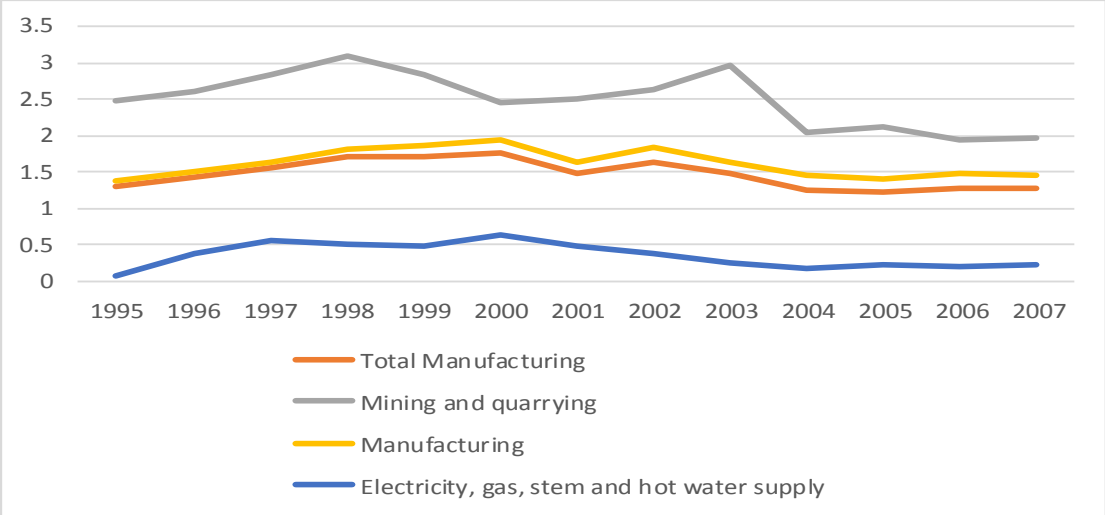
This non-parametric Hicks-Moorsteen Index approach is based on the growth of the accounting framework and therefore in this analysis the equation is taken from Jakubiak's (2002, 2006) studies:

[26] This category includes all three divisions: Electricity, gas, stem and hot water supply, Manufacturing and Mining and quarrying.

$$\ln(TFP_t) = \ln(Y_t) + \beta_t \ln(L_t) + (1 - \beta_t)\ln(K_t) \quad (35)$$

where t is year, labour share in production is β_t expressed as revenue-based, expressed as a ratio of total labour compensations to gross value added (*GVA*), L_t - where labour index is measured by three different proxies (*APE*), K_t is physical capital stock (GVFA) and Y_t is proxy for output (*GVA*). This index was computed for each of the three divisions of Manufacturing and for Total of Manufacturing; the results are presented in the figure below.

Figure 4.2. TFP trend analysis over period between 1995 and 2007



Source: Author's calculations on estimating the sector data from Statistical Yearbook of Industry from the Polish CSO (various years).

In the figure above, there is a slight upward trend in productivity, apart from Mining and Quarrying. However, there is a significant drop in 2001, and then a slowdown after 2004. Showing that these results are consistent with research results by Kolasa and Żółkiewski (2004), Dańska-Borsiak, (2011) and Jakubiak's (2002, 2006). The slowdown after 2004 might also have been caused by more intensive competition from abroad, as it is the period after the Polish accession into the EU. In this case, low productivity firms might have had to exit the Polish market as a result of increased competitions from export and foreign companies, causing this drop in the total production for domestic firms; which were replaced by higher productivity firms from the EU.

In addition, these companies were not able to adopt costly and technological innovations that could have increased the implementation of new processes and the development of new products, which could have led to step-changes in efficiency. As for the year 2000, it was an intensive period due to the disclosure of several corruption affairs and a significant fiscal crisis in 1999 which was triggered by the implementations of several reforms in the pension, education and local administration systems.

4.5.2 Empirical productivity results for the 22 manufacturing sectors (NACE three-digit classification)

Estimation productivity results for the manufacturing division are presented as TFP trends analysis for the period between 1995 and 2007, for 22 manufacturing sectors. And Appendix 4.4: Table 2 presents the summary statistics. In this section, the techniques applied are: parametric approach of estimation production frontier (OLS) and the Index approach-Hicks-Moorsteen Index.

The parametric approach of estimation production frontier for sector level base is computed based on value-added including sector and time effect.

$$\ln(Y_{jt}) = \alpha_o + \beta_L \ln(L_{jt}) + \beta_K \ln(K_{jt}) + \varepsilon_{jt} \quad (36)$$

where Y is gross value added (*GVA*), L is proxy via three different labour indicators (*APE*), K is a gross value of fixed assets (*GVFA*), j-is sector, and t-is year.

Then a non-parametric Hicks-Moorsteen Index equation, which is the same as the above analysis, follows as:

$$\ln(TFP_t) = \ln(Y_t) + \beta_t \ln(L_t) + (1 - \beta_t) \ln(K_t) \quad (37)$$

where Y is gross value added (*GVA*), L is proxy via three different labour indicators (*APE*), K is a gross value of fixed assets (*GVFA*), j-is sector, and t-is year.

An adaptation of these two different techniques, allows us to investigate the changes in TFP trends with respect to the socio-political changes. As, the TFP index method does not adopt the assumption of the constant size of coefficient over time, which allows us capture the transformation and political changes better as the adjustment of TFP Index.

In order to compute TFP, by the use of the parametric method, the first steps were to estimate the value of labour and capital coefficients and then to compute residuals. The estimation results are based on value-added estimation, showing that the labour coefficient is 0.63 and the capital coefficient is 0.33 (see Table 4.6 below). These results also confirmed, that manufacturing sectors are more labour intensive than capital intensive, and that these result are in line with the other publications regarding the Polish manufacturing sector (see Gradzewicz, Kolasa, 2004, Czyżewski, 2002, Kolasa, Żółkiewski, 2004).

Table 4.6: Production function estimates for manufacturing sector data (22 sectors), for gross value added (*GVA*) and average paid employment (APE)

Method	N	Coefficient of Labour	Coefficient of Capital
OLS	299	0.631136*	0.324756*

Notes: * the statistical significant level is equal and less than 5 percentages, *Source:* Author's calculations on estimating the sector data from Statistical Yearbook of Industry from the Polish CSO (various years).

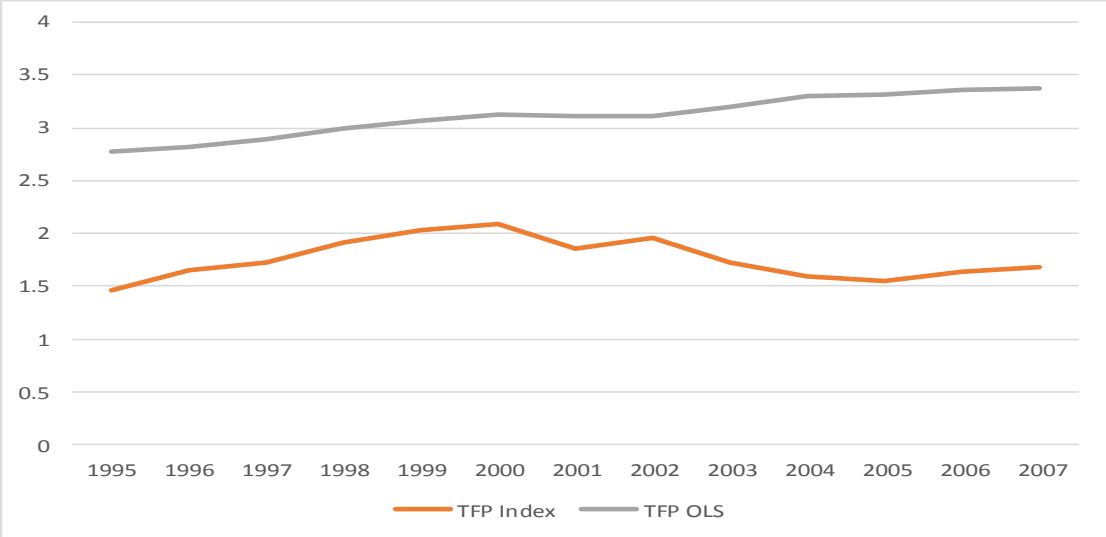
The figure 4.3 below, presents the analysis of TFP trends between 1995 and 2007. This figure is a graphic presentation to compare the different results of both the approaches of TFP measures. Both TFP measures show upward trends for this period and is similar to previous analysis of Total of Manufacturing. Also, these results seem to be consistent with Jakubiak's (2002, 2006) research, which used the same manufacturing data, but a shorter period up to 2004. Both measure TFP behaviours in the same way, with a strong upward trend for the period between 1995 and 2000, then there was a significant difference from 2001.

This upward trend, happened during the intensive process of privatization, changes in exchange rate regime and gradual schedule of capital account liberalization, and certain stabilizations of macroeconomic situations. Since the beginning of the 1990s,

the privatization process allows for state enterprises to be converted into state-owned corporations. This process is divided into two forms, such as 'corporatization' or liquidation. In case of these 'corporatization' privatizations, the employees in state-owned corporations had the right to elect one-third of the Board of Directors and the other two-thirds were selected by the owners of the corporation.

Another method of privatization was called liquidation. The liquidation method involved the transfer of assets of an enterprise into a new company, with a condition, that a majority of the employees become co-owners of the company. In this case, privatization was related to changes in ownership, whilst the intensity of capital account liberalization process happened. This change of ownership could have caused a better usage of resources, which could have transferred into an increase in productivity (see Kochanowicz, Kozarzewski and Woodward, 2005). On the other hand, there was a significant financial crisis in 1999, which was linked to several corruption affairs, which could have caused the effect in the economy and then productivity.

Figure 4.3. A weighted average of changes in TFP measures 1995-2007



Notes: The weight is the value of gross value added. *Source:* Author's calculations on estimating the sector data from Statistical Yearbook of Industry from the Polish CSO (various years).

As Figure 4.3 presents, there is more dispersion in the nonparametric method, when compared to the parametric measure. A logical explanation for this, is that there is no assumption of constant size of coefficient for labour and capital, for the TFP index measure.

4.6. Conclusion

The concept of TFP has been intensively discussed in literature since the 1950s work on Solow model adaptation. This chapter gives an empirical overview of the measurements of TFP and points out the problems of simultaneity of input choices and endogeneity of attrition within parametric estimations, at both the levels of sector aggregation and at firm-level. The literature also suggests various econometric methods to overcome these issues at the firm-level analysis but not for sector aggregation.

In this paper, TFP was computed for three different manufacturing sectors aggregation with respect to input choice for Polish manufacturing sectors, for the period between 1995 and 2007. The cross-time analysis was implemented for Total manufacturing, with respect to three divisions: mining and quarrying, manufacturing and electricity, gas and water supply. The panel analysis was used with respect to 22 manufacturing sectors according to NACE rev 1.1 classifications. We also used two different econometric techniques to compute TFP: the TFP index measure (non-parametric) and the parametric production functions estimation (OLS).

The evolution of industry TFP over the sample period, shows an upward trend at the establishment level, which seems to be consistent with existing literature of the Polish manufacturing sector. In addition, the elasticity of labour is relatively higher than that of capital, implying that labour plays a significant role in the production process, and therefore should be taken into account in policy recommendations for further transformation of the Polish manufacturing sector into a more capital intensive economy. Another finding, is that even if there are upward trends for different data aggregations, the value of TFP index is more volatile than the TFP parametric measure suggesting that is caused by a strong assumption of the fixed coefficient size on capital and labour over time.

Chapter 5: Capital Account Liberalization, Investments and Productivity - Sector Level Analysis

Abstract

There is now considerable evidence that Capital Account Liberalization (CAL) can enhance productivity on a macroeconomic level. However, there is still no agreed consensus in the empirical macroeconomic literature regarding the effects of CAL and financial development on sector level productivity and what transmission channels in this process have real manufacturing output. This paper develops two strategies to test the effects of CAL's on productivity in manufacturing sectors and find evidence of this relationship. The first empirical strategy employs the traditional on/off CAL measure, sectoral financial and liquidity dependence, and their impact on productivity. This strategy utilizes adaptations of Rajan and Zingales' (1998) and Levchenko et al.'s (2009) sector financial and liquidity dependency effect through the CAL process on productivity. In the second empirical strategy, we define several direct new capital transmission channels as proxies of CAL sector measures and then analyse its effect on overall productivity levels. This second strategy utilizes adaptation of these proxies of CAL sector measures and sector financial and the liquidity dependency effect on productivity.

To implement these empirical strategies we use a Difference in Difference estimation model using 22 manufacturing sectors in Poland between the years 1995 and 2007. The results suggests, that financial liberalization benefits Polish manufacturing sectors that depend more on externally financed investments and that these sectors should be productively beneficial. Concluding that there is statistically significant evidence for positive effects at the sector level, there is strong support for the allocative efficiency effect on productivity. However, there is little empirical evidence that a reduction of capital cost through liberalization could increase misallocation of capital into unproductivity projects so-called financial black holes. Because this negative effect of liberalization on productivity was not strong.

5.1 Introduction

Capital Control Regulations have eased and changed dramatically over the years, Poland is an example of a country that has undergone strong trends towards gradual liberalization. Concurrently, the productivity has correspondingly matched growth at a significant pace and faster than the CAL process in Poland.

What are the effects of CAL on a country's economy? There is mixed evidence that has been found in the literature.[1] In spite of a neoclassical theoretical case, CAL should improve the allocation of resources, especially capital, and then, expand productivity growth. On the other hand, this positive economic effect is under requirement for the risk of global navigation of the environment such as investor's animal spirits, boom-bust cycles, procyclical nature of capital and capital flight's financial crisis, banking crisis, and currency crisis.[2] Reasons of inconclusive results between the CAL and productivity may be a lack of the implementation of the CAL processes on sector level analysis.

This paper examines the relationship between CAL, investments and productivity growth. An investigation of Polish manufacturing sector data was done, between 1996 and 2007, in order to answer the following empirical questions:

First, what is the impact of financial liberalization on output growth at the industrial level, why is it essential to consider these effects within a unified empirical framework rather than existing theoretical works and how productivity growth trends affect the Polish economy?

Second, why is there a differential impact on productivity growth across different industrial sectors characteristics?

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[1] See Alesina, Grilli and Milesi-Ferretti (1994),Rodrik (1998), Quinn (1997), Edwards (2000), Edwards (2001), Kraay (1998), Klein and Olivei (2000), Chanda (2001), Arteta, Eichengree and Wyplosz (2001), Bekaert, Harvey, Wyplosz (2001), Edwards (2001), O'Donnell (2001), Reisen and Soto (2001), Edison, Levine, Ricci and Sløk (2002), Edison, Klein, Ricci and Sløk (2004) – However, among these huge literature of CAL and economic growth, only Edwards (2001) has calculated the impact on CAL on TFP growth. On sector country level Levchenko, Ranciére and Thoenig (2009), they do not detect any impact of liberalization on TFP growth.

[2] For instance, limitation of volatile short-term capital flows might avoid a balance of payment crises, exchange rate volatility and the spread of economic shocks. The pioneers of this line of thought were Tobin (1978) and Dornbusch (1986). Tobin proposes imposing uniform tax on all foreign exchange transactions to discourage very short-term capital flows. Dornbusch (1986) suggests the adoption of measures such as a dual exchange rate System. (See Kose Prasad Rogoff and Wei, 2006)

Third, are there any direct transmission channels from CAL to productivity growth in individual firms/sectors other than those identified by Obstfeld (1994), Hendry (2006) or Gourinchas, and Jeanne (2002)?

Therefore, the approach of this paper is to test the hypothesis regarding sector impact of CAL on productivity and investments via these channels, defined as a proxy for the CAL sector. Due to financial liberalization, credit constraints are eased on firms more intensively capital dependent and, therefore, allows for the movement of resources from inefficient to efficient firms (Gadio, 2006, Levchenko et al., 2009). As Rajan and Zingales (1998) point out, firms which are more dependent on external finances[3] should benefit more from CAL through the access of more or larger amounts of capital resources, then discussing how internal financing is expected to be incorporated into productivity grow.

The fourth supportive question asks if it is a true hypothesis that sectors, which depend more on external finance, should benefit more from the CAL process. Also, this paper investigates the effect and degree of the liquidity sectors' dependence via a ratio of inventory to sales and Cash Convert Cycle following Raddatz's (2006) analysis. It is also worth checking, how CAL direct transmission channels are related to financial and liquidity dependency sector effect and, then, how this affects sector productivity?

In order to answer these questions and test the hypothesis, the following methodology is estimated via a balanced panel of 22 manufacturing sectors in Poland over the period 1996 to 2007. In line with proxy CAL measures specifications, the empirical strategy is centred on exploiting the different effect of Capital Control reform on sectors, in accordance with their degree of financial and liquidity dependence. The empirical strategy to estimate this CAL effect makes use of the following econometric techniques: Difference in Difference estimations and two measures of TFP productivity (TFP index approach and TFP OLS).

The rest of the paper has been structured into four more sections. Section 5.2 describes: i) Polish political background and ii) existing literature on the relation between CAL and productivity at the sector level. Section 5.3 describes CAL sector of proxy measures and then introduces the variables used in the empirical model and

[3] A company raises these findings from sources other than itself, such as corporate bond or stock issues.

delineates the estimation strategy. Section 5.4 presents the estimation results and Section 5.5 the conclusions.

5.2 Literature Review

Polish political background

Between 1995 and 2007, Poland was strongly involved in the process of European integration as well as Capital Account Liberalization (CAL). A gradual schedule of CAL was adopted by being a member of the IMF in 1995, followed by OECD membership in 1996 and a member of the EU in 2004. However, compared to other post-soviet countries such as Czech Republic or Russia, after 1995, Poland did not suffer any serious financial or currency crisis. The lack of these serious financial instabilities might be caused by the adoption of a gradual schedule of CAL (see Chapter 1 Table 1.1) that also started along with the gradual macro-economic development and monetary exchange rate policies that started in the 1990s. Nonetheless, Poland had a more complicated fiscal situation especially in the period between 1997 and 2000. From 2000 the fiscal situation improved until 2007 (Kochanowicz, Kozarzewski, Woodward 2005). The on/off index ($imf_{x,t}$) based on IMF'AREAER confirms that Poland liberalized capital flow since 1998. This CAL process was strictly linked with the Polish privatization process. The Privatization Act of 1990 ensured that privatization took place in two main forms: commercialization and liquidation. This process caused that many state-owned companies were transferred to foreign ownership. In 2004, Poland joined European Union. Poland was under significant transformation changes apart from CAL process.

Theoretical discussion about CAL and economic growth

The theoretical discussion about the link between CAL and productivity growth will be centred on two main channels.

The "*positive"* channel increases productivity growth through allocative efficiency, improvement of macroeconomic-political reforms and proper sequence of CAL reforms. This channel suggests that removal of market impediment through CAL moves the economy into a higher equilibrium and smooths consumptions via direct and indirect effect on investments. Direct effect is strictly connected and will immediately show

changes on the stock market exchange or through FDI investment flow cost on inter-company loans (see Sulimierska, 2008b and Desai, Foley, Hines 2003). On the other hand, an indirect effect is linked to the financial development and depth and externalities of foreign companies' participations in domestic markets.

The "*negative*" channel on productivity is defined through imperfect market (asymmetric information, moral hazard) and other distortions (economic shocks, weak legal framework of developing countries), which can lead into financial instability, banking bust-boom, financial and currency crisis and later, into economic stagnation. Also, a shift from Capital Control regime can reduce production efficiency, because less efficient companies might benefit through a reduction of cost, regain additional capital resources and then invest this capital into unproductive projects. This effect is a financial black hole events (see Ranciere and Tornell, 2011).

Until recently, most of the empirical literature studying CAL used country level data and did not find conclusive evidence that CAL has strong positive impact on economic growth (see Kose et al. 2003, 2006, Prasad et al. 2003 and 2006).

Some studies found that financial liberalization and Capital Account Liberalization do not affect growth and even that the effect of liberalization was temporary through capital inflows (Grilli and Milesi-Ferretti, 1995, Kraay, 2000 and Rodrik, 1998). Then Eichengreen and Leblang (2003) and Edwards (2001) identified that it is a negative effect, which is heterogeneous across countries at different economic and institutional developments. Others have also found that the effect is positive, for instance, Bonfiglioli (2008), Kose, et.al. (2009), and Bekaert, et al. (2011) argued that the growth gains from financial liberalization come from an increase in aggregate TFP rather than from an increase in aggregate capital accumulation. As Kose, Prasan and Terrones (2006) have pointed out, there is little evidence of the positive impact of CAL through capital accumulation channels on productivity growth.

A majority of country-level studies employed rules-based CAL measures, based on IMF's AREAER, but these measures may not be precise and do not always hold in real life. As Henry (2000 a,b) pointed out, market players always find a way to avoid the legal Capital Control regulations through the effect of leakages to private investors, as in the

case of Indian ADRs. Some studies have also employed continuous intensive measures (see Lane and Milesi-Ferretti, 2001, 2005, Henry, 2006).

In this situation however, these continuous intensive measures may also include other macroeconomic changes such as privatization and macroeconomic stabilization reforms instead of the CAL processes. Then, there is some significant literature that analysed the CAL process as the Stock Market Equity liberalization (see Chari and Henry, 2002, Johnson and Mitton, 2003, Forbes 2003, 2007). These studies moved in as three-dimension panels, analysing each country thoroughly, investigating the channels between financial liberalization, capital accumulation and productivity growth. Chari and Henry (2002) and Abiad, et al. (2008) found significant effects of equity market liberalization on investment by comparing the dispersion of Tobin's q among listed firms and concluded that it might bring a positive impact on productivity but it is not conclusive.

Then Ranciere and Tornell (2011) extended upon this analysis to include the effect of misallocation in investment allocation, by implanting financing constraints and Tobin's q among firms within the sector. The financial analysis measures related mostly to stock market liberalization indicators, which as a specific type of a larger policy reform are called Capital Account Liberalization. Most of Stock Market Liberalization measures have a binary character and tend to measure only the dichotomous nature of liberalization and do not focus on the gradual financial or capital impacts of liberalizations on other economic parameters of interest (see Henry 2006).[4]

Moreover, there is an uncertainty in developing countries with respect to SML indicators inaccuracy. For instance, the inherent high riskiness of stock markets in developing countries may hinder the flow of capital in the stock exchanges rather than mere capital restrictions. The most common method to define SML data in three-dimension panels includes, firm-level data to analyse ratio between IFCI and IFCG index (see Henry, 2000, 2003, 2006). The majority of these SML studies found evidence of the liberalization impact of reducing capital cost or increasing volatility of the stock

[4] For instance, Capital Control of different intensities may not be equally effective in containing threats to currency stability and different types of control and different forms of liberalization may have different implications for financial stability.

exchange. The other group of three dimensional model studies focuses on the globalization of capital and financial markets, which reinforce the effects of transfer pricing[5] and other tax-avoidance strategies of multinational firms and banks[6]. For instance, Desai, Foley, Hines (2004) found evidence of a positive relationship between the increased Capital Liberalization process and the stronger effect of tax-avoidance among American subsidiaries operating abroad, which might have a negative effect on productivity.

Apart from the three-dimensional panel firm-level literature, there has been a notable and significant growth of sector-level studies. The pioneering differences in the sector characteristic literature are Rajan and Zingale's (1998), which line of research was further developed by Galindo et al. (2002), Gupta and Yuan (2006) and Levchenk et al., (2009). The literature results suggests that CAL allows obtaining better financial services to companies so as to increase access to external financing, capital accumulation and then, spur productivity. This rise in productivity is caused by an increase in allocative efficiency (see Galindo et al. 2002). The use of sector level data therefore, enables a more thorough understanding of the impact that the CAL has on productivity; however, apart from analysing the channel of external funding, there is significant space for development.

To my knowledge, there are no investigations due, regarding the interaction between CAL and production on the sector level of the Polish case. However, the process of liberalization of capital control in Poland has been analysed in seventeen different studies as a part of a cross-country analysis.[7] Furthermore, among empirical analysis

[5] De Boyrie, Pak, Zdanowicz (2001) state the weak money laundering law might increase the number of false invoicing international trade. It is the case of enactment of Switzerland's antimony laundering law in January 1998, which was The Federal Act on the Prevention of Money Laundering in the Financial Sector- Money Laundering Act. This study indicates that there were significant changes in the degree of abnormal international trade pricing after the enactment of Switzerland's anti-money laundering law.

[6] The taxation of capital more generally becomes problematic under a situation of high capital mobility, since such taxes can be evaded by taking funds out of the country. Individuals and multinational corporations can shift taxable income from the country in which it was earned to another country in order to minimize income tax payments. With high capital mobility, the taxation of capital would leave the domestic economy with a suboptimal capital stock, since owners of capital would require an after-tax rate of return in the domestic economy equal to the pre-tax return available externally Montiel (1994, p.3).

[7] Rodrik(1998), Krkoska (2001), Edison and Warnock (2003), Buiter and Taci (2003), Kose, Prasad and Terrones (2003), Miniane (2004), Arvai (2005), Lane, Milesi-Ferretti(2005), Lane, Milesi-Ferretti (2006a), Lane, Milesi-Ferretti (2006b), Alfaro and Hammed (2007), Chino and Ito (2008), Sulimierska (2008b),

there is none that discussed CAL in Poland and its impact on productivity. These studies analyse the effect of CAL on different aspects of economics such as the risk of a financial crisis, volatility of consumption/production or economic growth.[8] The literature on productivity in Poland is not as wide as the one described in the previous chapter; it consists of 24 studies of which four papers were firm-level analysis, three papers were sector level analysis and only a few focus on TFP. As a result of, there is space to investigate these two issues of CAL productivity interaction based on the Polish case.

5.3 Data and Methodology

This section provides the data sources and the methodology to identify proxy CAL sector' measures and industry characters. It also describes the estimation equations techniques.

5.3.1 Data Description

The Data was mainly obtained from the Central Statistical Office (CSO), which is issued annually in the *Statistical Yearbook of Industry*. This data is in accordance with the Polish Classification of Activities (PKD) which are compiled on the basis of the Statistical Office of the European Community EUROSTAT publication *"Nomenclature des Activités dans le Communauté Européenne –NACE rev. 1.1*". The *PKD* was introduced in 1995 by decree of the Council of Ministers regarding the Polish Classification of Activities. All companies in Poland receive a REGON number and all firm data are collected by three main surveys SP, FO-1 and RF-01, which provide simplified balance sheet reports and cash flows. Based on this survey data, CSO calculated indicators for manufacturing sectors, Data regarding the financial management of companies include economies and entities keeping accounting ledgers employing more than 9 employees.

Mitton (2006), Gozzi, Levine and Schmukler (2005), Damijan, Rojec, Majcen and Knell (2008) and Kolasa (2007)

[8] Among all 17 papers, 8 indicate a positive impact on the economy (all 4 papers are microeconomic studies), 5 papers point out a negative impact and 4 papers provide evidence of mixed results. CAL quantitative measures were used in a Polish analysis, especially in International Capital Flows indexes.

However, one problem is that this technology-processed data is based on firms that employ more than 50 workers. All variables were deflated to 1995 prices level.

The empirical analysis of this chapter investigates one of three divisions: "Manufacturing", which included 22 sections (Appendix 5 Table 1). The research period is between 1996 and 2007, however, trade data are available for the period between 2000 and 2007 from CSO. In order to expand trade data, 3-digit level trade data from UN Comtrade (ISIC Rev. 2 classification) was used and converted to NACE Rev. 1.1 classification.

Also, the data to measure the intensity of legal changes with respect to the CAL process on a country level has been obtained from IMF's AREAER and variables are defined as $imf_{x,t}$. It is the most standard index in the empirical literature to measure CAL process as it is described in Chapter 2. According to this index, Poland liberalized capital flow from 1998. The dependent variable is defined TFP index and TFP OLS measures, which were taken from Chapter 4. The lists of all variables are in Table 2 and 3 in Appendix 5. These summary statistics are presented in Table 6 in the Appendix.

5.3.2 Methodology for de-facto CAL measures

This section has two main parts. First, it is a description of the transmission channels of capital flow on company level. Second, this section proposes methods to calculate these transmission channels on a sector level.

CAL - Microeconomic measures (proxy)

There is a need to develop more precise measures with regards to CAL in its usage within the industry and to investigate more details of the CAL process. The sector level analysis of CAL allows us to identify the relations between cross-country capital regulation with individual firms' behaviour and their response to the sequence of the liberalization process. In addition, avoiding Capital Controls Regulation through the taxation-evasion process can be analysed.

In order to develop these CAL sector proxies, it is important to start by looking at the firm–level perspective of capital transmission. It can be analysed through a single

company capital transmission flow with closed economy and then with open economy as these capital transmission flows might be affected by the CAL process.

Idea of CAL - Firm measure

It is now established that using individual firm-level data provides a better understanding of the linkages between productivity growth and CAL, especially in the context of financial constraints and firm investments (see Harrison, Love, McMillan 2002). An in-depth analysis of firm's responses to capital account restrictions provides a clear picture of the actual restrictions that firms face.

In this paper, a new approach to the CAL measurement is developed. This methodology proposes a range of CAL measures using balance sheets and cash flow statements of individual companies. It identifies both inward and outward capital flow channels in a company. It then investigates the effects of CAL on these capital flow channels.[9] The following cross-country measurement methodology of CAL, a new CAL proxy, is computed as a financial indicator in proportion to the firm's output. This is similar to the measures of capital flows in proportion to GDP (see Swan 1998, Kray 1998).

In order to appropriately describe the new proxy measures, the analysis is divided into two steps: first, the capital flow transmission channels in an individual firm in a closed single country and then, open economy with all firm's linkages and interactions in multinational corporations. Due to the sector level data limitation for Poland, the second step is described briefly.

Transmissions capital flow channels for a single company

This section looks at identifying transmission mechanisms and methods to measure them. It also analyses the techniques and strategies employed by firms to circumvent taxation.

[9] The CAL process is broadly described as i) Trade Liberalization, focussing on the liberalization on the flow of goods and services and, ii) Capital Account Liberalization, focussing on the liberalization on the capital flows in the financial sense. The traditional definition of CAL includes both the legal restriction on trade of goods and services and financial flows of capital but, in order to simplify the analysis, the trade liberalization was excluded.

This starts with a single industrial firm[10] in a closed country framework. The analysis of a company's capital structure i.e. cash flow statement[11] and balance sheet[12] shows two aspects, the exogenous aspects include taxations, financial and stock market development. The tax is imposed on all levels starting with individual employees (income taxes) up to company level (corporation taxes). Primarily, the country is closed from the rest of the world in two dimensions (1) goods and services flows and (2) financial capital flows. The endogenous aspects include capital flows transfers within/outside the company in order to maximize profits.[13]

Figure 5.1 presents the link between CAL processes with firm behaviours perspective to build macroeconomic models out of microeconomic firm cash flows foundations.

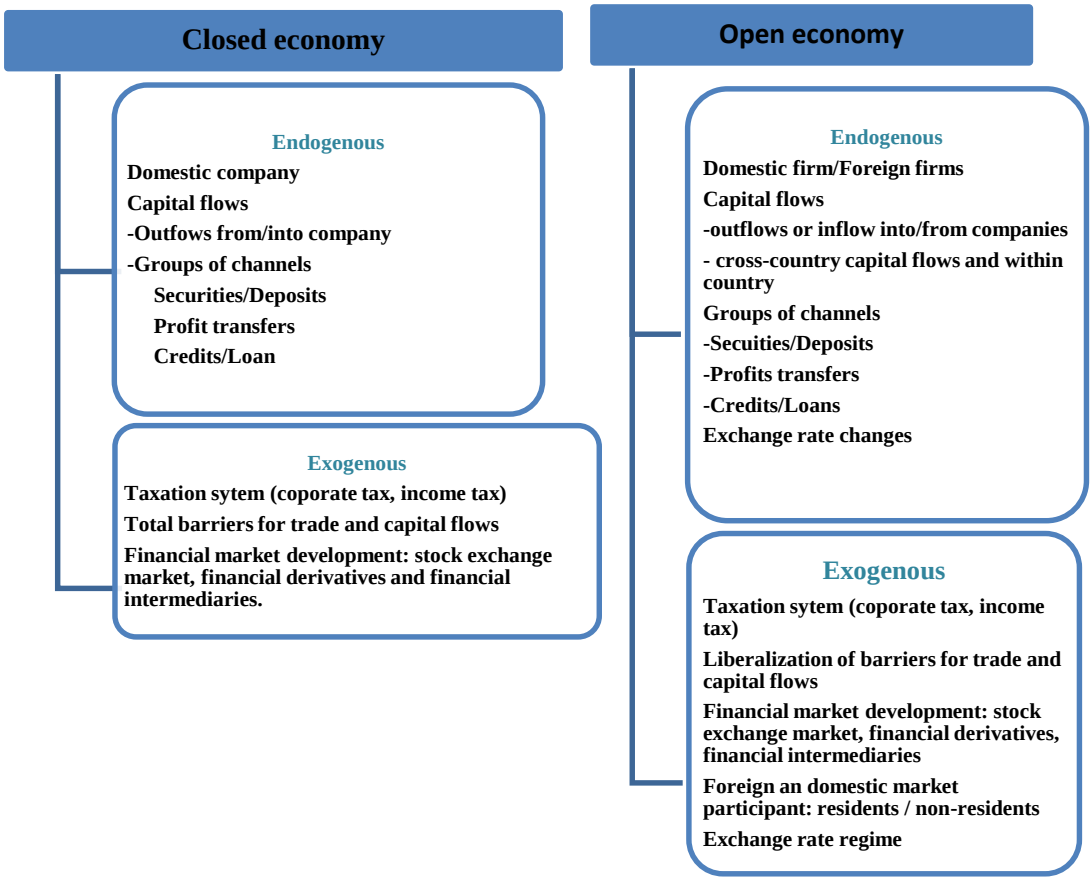
[10]According to Pawlic (2003), firms might be analyzed with respect to two perspectives such as inter-companies linkages or the interactions between individual companies. In the corporate organization, companies might be defined as either of the following: i) single independent companies (subsidiary, branches, or affinities or divisions) or ii) corporations with subsidiaries (a group company or holding companies where the relation is a mother-daughters). The main differences between division and branches are the level of integration with the parent company. Branches are a kind of subsidiaries, as every subsidiary is separate, distinct legal entities in the context of taxation and regulation. However, other divisions can be in businesses that are fully integrated within the main company, and not legally or otherwise distinct from it. A group company is defined as a parent and all its subsidiaries together, or can also be cooperating companies and their subsidiaries with varying degrees of shared ownership. A holding company concept is a related group of firms where one company owns a majority of shares in another company. Usually, this company is called a holding company, which does not produce goods or services itself, but, rather, owns shares of other companies.

[11] This statement is classified into three groups: operational cash flows, investment cash flows and financial cash flows. The first group refers to income and cost of a company's internal business activities such as sales, materials and labour. The second group links to inflows from the sale of long-term assets or outflows on capital expenditure such as investments, acquisitions and long-life assets. The last group is the capital flows resulting from the issue of shares, payment of dividends out, and taxes. However, in our analysis, the cash flows refer to only a subset of those flows, which are important for CAL and economic growth.

[12] The balance between ownership equity and long-term credit creates the company's capital structure.

[13] These assumptions are unrealistic but allow to understand the capital flows channels in a company

Figure 5.1. Single country analysis for development of CAL microeconomic - level measure methodology



Source: Author's own analysis.

In these instances, we have capital *inflows (inward)* in a company if there are cash flow transactions from outside the company, which increases the available cash within the company, i.e. "company has additional injection of cash". The inward transactions are connected with asset position in the balance sheet of the firm. The assets define how much a company has in its possession or how many other market participants have liabilities in this company. On the other hand, the capital *outflows (outward)* from the company indicate an increase in the value of the company's obligations to other entities, i.e. "company has additional outflows of cash". Outward transactions essentially belong to the liabilities' side in the balance sheet of the firm. The liabilities inform us how much the company owns with regards to other market participations. Inward transactions are denoted as "*i*" and outward ones are described as "*u*". Given this definition of capital *inflows* and *outflows*, Table 5.1 presents three groups of channels that are defined to develop firm-level measures: i) Deposits and securities' i.e. financial investments ii) Loans and credits' i.e. debt transactions iii) Profit transfers.

The firm-level measures were analogously constructed to capital flows indicators (see Swan 1998, Kray 1998), each category of the capital flow transactions were divided by the firm's output as a ratio of X and Y (X / Y) where X is the sum of value of one of three categories and Y is Gross Value Added.

Table 5.1: Capital flow mechanism in a single company in a closed country

Outward flows ("Company has additional outflows of cash")		**Inward Flows ("Company has additional injection of cash")**
Purchase of securities: bonds or shares Take deposits	**Equity Securities and Deposits**	Issuance of equity securities Give deposits
Provide credits and loans by financial intermediates and inter-companies credit transactions such as inter-company loans, trade credits	**Credits and Loans (Debt Securities)**	Take credits and loans and inter companies transactions such as inter-company loans, trade credits, issue of corporate bonds
Visible transfers (dividends, investments in fixed assets, interest payment out of securities and bonds) Invisible transfer (profits shift)	**Profits Transfer**	Visible transfers (dividend payments, interest payment from issuing equity and debt securities. Invisible transfers (profit shift)

Source: Author's own analysis.

In order to describe the framework, we define profits using the operational cash flows of the cash flow statement and the Cobb-Douglas's production function (Bauer 1988, Bosca, Escriba, Murgui 2004). Profit is the difference between sales revenue (R) and cost of production (C). The '*gross*' profit can thus be defined as $\pi = R - C = \sum_j y_j p_j - \sum_i w_i x_i$ where C-observed cost of inputs such as materials, labour and capital, w_i - the price of the i[th] input, x-quantity of inputs R- sale revenue, p_j -price of the j[th] output, y-quantity of output. The cost of production might be described as: $C = Lw + Mc + Kr$, where L-number of workers, w-wages, m-quantity of intermediate inputs, c-price of intermediate inputs, and K- fixed assets and r- rate of depreciation (Kr-total depreciation in company).

The profit transfers are divided into two parts: (i) visible transfers[14] that relates to retained earnings (paid as dividends to shareholders and re-investments) and (ii)

[14]There are two categories such as visible and invisible transfers. The visible profit is the amount of profit which can be seen with taxation perspective by domestic government. The invisible profits are not

invisible transfers that include legal or illegal corporations' action to avoid taxation. All financial costs connected with investment and debt transactions are investigated independently under two categories - deposits/securities' transaction and loans/credits' transaction. These two categories are affected by SML or reductions in capital control regulation for financial institutions.

Equity Securities and Deposits Category

In principle, securities and deposits category represents liquid assets in the balance sheet of the company, it includes all financial and money market instruments[15] that the company may invest their profits in both short-term and long-term investments. The first group called securities and deposits have two main subcategories, securities flows (denotes as "S") and Deposits (denotes as "D"). These inward security flows (S_i / Y) are represented by all transactions in the balance sheet where the company is0sues equity securities.[16] On the other hand, outward equity security flows (S_u / Y) include purchases of these securities.[17]

Then, an inward deposits category (D_i / Y) takes account of the value of the given deposits[18] as well as outward deposit transactions (D_u / Y) that defines the value of the deposits. The value of closing deposits includes the value of transfers from financial intermediates into a company's account. On these basis, two indicators were derived: Security index and Deposit index. The equity security index is computed as follows: $\Delta S / Y = (S_i + S_u) / Y$ and then, a deposit indicator is achieved according to this formula $\Delta D / Y = (D_i + D_u) / Y$.

obverted the government which was illegal profit shifting. The re-investments of liquid assets is analyzed in the category "Securities & Deposits".

[15] Bonds definition includes bonds denominated in foreign currencies, common stock, long-term and short -term notes, deposits, certificates of deposits

[16] Examples: Total value of purchasing debt securities such as corporate bonds, government bonds.

[17] Examples: Share of capital equity in domestic companies (issuance of equity securities)

[18] Example: Total value of other capital unit participations in non-financial enterprises

Credits and Loans Category

The credits and loans category represents debts and obligations of the company; the borrowings are injections of additional funds into the business to stabilize a company's financial liquidity situation. A firm can consider obtaining additional financing in two ways: (i) company-company or (ii) company-financial intermediaries (Rutkowski, 2005, Harrison and McMillan, 2003).[19] Company-company (endogenous) transfers include debt instruments such as (i) trade credits[20] and (ii) inter–company loans[21] (see Table 5.1). Company-financial intermediaries (exogenous) transfers take into consideration direct and indirect financing. The cost of these loans depends on the company's economic situation that includes capital structure of company, size of the company[22] and individual relationships with financial intermediaries (see Table 5.1).[23]

The second group called Credits and Loans (denote "C") was calculated as $\Delta C/Y = (C_i + C_u)/Y$ where inward capital flows (C_i/Y) is a value of liabilities in a company's balance sheet such as issuance of corporate bonds, taken credits or intercompany loans. Outward flows (C_u/Y) include credits, loans and inter-company loans which were given to a company.

[19] This group is connected with concept of company's credit constrains.

[20] Trade credit is an arrangement for payment for purchasing goods and services between businesses but without making immediate cash payment. This financial transaction is linked with vertical relation between supplier of inputs, producers of final goods and customers (distributors of final goods –e.g. supermarkets). For example, the supplier provides the customer with an agreement to charge them later by setting up a fixed number of days or other date by which the customer will pay. In that way, the customer obtains goods without paying for a certain amount of days, -under given inflation and interest rate on the market-customer obtain credit. This arrangement might be between the supplier of inputs and producers of final goods, and producer of final goods and distributor of final goods (see Pawlik, 2003).

[21] Intercompany loans are lending agreements between two divisions in the same group of firms (company), when a subsidiary (parent-mother) is the lender and the parent (subsidiary) is the borrower. The loan might be given between two subsidiaries (see Henry, 2007). This concept is based on the horizontal ownership relation (parent-head office), subsidiaries, and subsidiaries of subsidiaries. For instance, FDI horizontal are defined on horizontal relation inside companies (see Pawlik, 2003 and Desai, Foley and Hines, 2004).

[22] Companies might be separated according to size. There are SME (Small and Medium Enterprises) and large companies. This classification depends on the number of employees or size of assets, productions etc.

[23] Firms belong to holdings when one of the divisions is a financial institution such as investment banks.

Profits Transfer Category

The invisible profit transfers need to be considered independently because all sections in Table 5.1 are directly or indirectly affected by unseen profit transfers, which are essentially different methods adopted by a company to circumvent taxation regulations. The main ways of avoiding the taxation system in a closed country are transfer pricing, intercompany loans, changing of trade credit conditions, Fronting Loans and unbundling of Capital Service Payment (see Sulimierska, 2008b).

The more complicated the structure of the company is (e.g. affiliates, subsidiaries) the more avenues it has to avoid taxation. The analysis of a single closed country, as it is this case, avoids complications related to the effect of cross-country taxation regulations on individual firms since all companies have the same taxation system.[24]

The third group called profit transfer was computed as $\Delta\pi / Y = (\pi + u\pi)/Y$ where visible profits are as "π" and invisible profits are denoted as "uπ".[25] These outward visible profit transfer flows (π / Y) represented by all transactions in the balance sheet, all represent a company's spending of gross profits such as re-investment of retained profits, interest payment for debt securities and dividends payments to shareholders. Then, the inward visible profit transfer flow ($u\pi / Y$) is considered as profit transfer from subsidiaries and interest payment into a company for its securities or deposits. The outward and inward transactions for invisible profits have a similar definition as for visible profit. The crucial difference is that invisible profit includes transfers in order to circumvent taxation regulations.

Capital flows cross borders

[24] A tax haven imposes not more than nominal taxes to non-residents, which is mainly lower than taxation in their country of residence, plus it might engage in harmful tax practices and be characterized by a refusal to exchange information to other tax authorities (a lack of transparency) (see Sohn 2002). According to OECD, there are 35 jurisdictions that identify tax havens: Andorra, Anguilla, Antigua, Aruba, Bahamas, Bahrain, Barbados, Belize, British Virgin Islands, Channel Islands of Guernsey, Sark and Alderney, Cook Islands, Dominica, Gibraltar, Grenada, Isle of Man, Jersey, Liberia, Liechtenstein, Maldives, Marshall Islands, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, St Kitts and Nevis, St. Lucia, St. Vincent, Seychelles, Tonga, Turks and Caicos, US Virgin Islands, Vanuatu, Western Samoa.

[25] Examples of visible profit shifts: dividend payments to shareholders and total value of financial account receivables from other subsidiaries.

Compared to the previous section, this section investigates and analyses the case of a single country with open capital flows. Not only do capital flows take place between companies but these flows also happen between country borders (Figure 5.1).[26] Cross-border transactions might be conducted in different currencies for the trading of goods, purchase/selling of properties or/and purchase of various securities.

Identified company capital flow transmission channels are similar for a closed and an open economy (see Figure 5.1). In this case, the subcategories of capital transactions are explained in each of the group channels that are related to cross-border transactions (see Figure 5.1)[27]. A cross-country capital transaction is defined according to the transaction location and residency of the transaction participants. A cross-country capital transaction is defined as; if the country is an open economy and transactions are done with foreign participants. Also, if a transaction happens outside the domestic market. Table 4 in Appendix 5 shows presented capital *inflows* and *outflows* according to three main groups of channels to compute CAL firm-level measures.[28]

Proxy of CAL sector measures

The next step is to provide a practical implementation for the transmission of capital flow channels on firm level production to develop the proxies for the CAL sector-level measures. There are three main firm-level surveys collected by the Central Statistical

[26] In a closed country, there are two types of companies: i) single firms (self-sustaining entities) and ii) groups of firms (holding structures). As a result of capital flow liberalization there are two other entities, such as foreign and domestic firms on the market. These two entities can also have vertical and horizontal connections. However, these connections may be split up outside the borders of the country (for instance, FIAT has subsidiaries in Poland and its head office is in Italy). Also, CAL is analyzed as Trade Liberalization (this process includes all good transactions) and Capital Liberalization (this process considers all financial transactions).

[27] Therefore, the logic is still similar with the closed economy analysis of inward and outward capital flows. In this case, subgroups are defined in the following way: i) Capital transactions within a country and outside a company are denoted as "*du*"- for instance, X_{du}/Y; ii) Capital transactions within a country and within an organisation (in the holding company or a group of companies) are denoted as "*di*" - for instance X_{di}/Y ; iii) Cross-country capital transactions and outside a company are denoted as "*cu*"- for instance, X_{cu}/Y; iv) Cross-country capital transactions and within an organisation are denoted as "*ci*" - for instance, X_{ci}/Y .

[28] Generally, almost all outward transactions are connected with negative changes in assets position or positive changes in liabilities in the balance sheet of the company, and inward transactions are linked to positive changes in assets position or negative changes in liabilities in the balance sheet of the company.

Office (CSO) in Poland: SP survey, FO-1 and RF-O1.[29] These surveys, which include individual information under Polish law and firm-level information, are not available for research purposes.

Therefore, it is not possible to compute CAL proxy measures on a firm level, especially to define inward and outward transactions. The manufacturing sector data on these three digits NACE classification are available with aggregated information from previous firm surveys. In order to measure capital flow transactions and compute proxies for CAL sector level measures, it was necessary to understand the linkages and the practical aspects of computation on the firm level. The manufacturing sector level data also allows us to obtain proxies for aggregate measures for each of the categories that were defined on firm level analysis, such as Securities and Deposits, Credits and Loans and Profiting Transfer (see Table 5.2). All cross-border capital flows transactions might be significantly affected through the CAL process, consequently those aggregates categories are also influenced by this process.

After defining variables in CSO for each transmission capital flow channels, it is possible to identify proxies for CAL sector-level measures ($Sector\ CAL_{\ it}$). All proxies for CAL sector measures are divided into three main groups the same was as firm-level measures: the equity securities and deposits category, the credits and loans category and profit transfer category.

[29] SP survey contains information from the firms' annual statistic balance sheet, FO-1 includes the annual cash flow statements for individual companies and RF-O1 is the quarterly statistical report of financial assets and liabilities.

Table 5.2: Transmission capital flows mechanism on sector level

Categories of capital transactions	Definition of Inward/Outward Flows	Variables categories for Polish CSO
Securities and Deposits	This category includes inward transfers such as issue shares and taking different types of deposits. And outward transfer includes a purchase of different securities such as bonds and shares or given deposits to other branches.	Share capital
Credits and Loans	The following aspects were included in these categories such as Credit and loans provided for banks or other financial institutions, inter-company loans, issuance of debt securities such as corporate bonds, debenture, etc. and, lastly, trade credits. As it was described above, these subcategories were analyzed as outward and inward flows from a company.	Long-term liabilities credits and loans Short-term liabilities credits and loans Short-term accrued assets Short-term account receivables assets Short-term account receivables assets (Deliverables and Services) Short-term liabilities account receivables
Profits Transfers	The profit transfer category includes: -Visible transfer in company book-keeping such as dividends, interest payments from securities and bonds, investments in fixed assets, interest payments out of securities and bonds. _____ -Invisible transfer so –called profit shift	Financial revenues on Economic Activity Net financial Results Retained Earnings _____ Expenditure on innovations (marketing) Expenditure on innovation know-how

Source: CSO- manufacturing data for Statistical Yearbook of Industry from Central Statistical Office in Poland.

Equity Securities and Deposits Category

This category includes information about the issuance of shares, purchases of different equity securities, and deposit transactions. It is closely related with share capital. According to CSO, a share capital includes the following categories: core capital, supplementary capital, reserve capital for revaluation of other reserve capital funds, undistributed (unsettled) financial results from previous years and net financial results for the turnover year.

In other words, share capital is represented as the share of the company's equity that has been created through trading of the company's stock. This share capital is defined as the sum of nominal value of the company's shares multiplied by the number of its included shared premium. In this case, the securities and deposits category is directly linked to the share capital, allowing us to create the following index to measure this category on the sector level.

$$SD_{i,t} = \frac{\text{Share Capital}_{i,t}}{\text{Gross Value Added}_{i,t}}$$ where *i-ith* manufacturing sector, *t*-year

Credits and Loans Category

This second category covers the information corresponding to short and long term liabilities for other entries (such as financial institutions or suppliers) or other company branches. This category is reflected in the following CSO indicators: long-term liability credits and loans, short-term liability credits and loans, short-term accrued assets, short–term account receivables, short-term account receivables (Deliverables and Services). According to the CSO, data the liabilities of enterprises are considered as all liabilities from bank creditors. The distinction between short or long term was done on the basis of the duration of the repayment period on the balance day. If the duration is longer than one year, then liabilities are defined as long-term, otherwise it is a short-term company obligation. In this case, the credit and loan indexes for banking obligations is:

$$BCL1_{i,t} = \frac{\text{Long - term liabilities from banks}_{i,t}}{\text{Gross Value Added}_{i,t}} \quad BCL2_{i,t} = \frac{\text{Short - term liabilities from banks}_{i,t}}{\text{Gross Value Added}_{i,t}}$$

where *i-ith* manufacturing sector, *t*-year

However, the CSO's statistical yearbook for industry does not provide information regarding other enterprises and financial obligations such as inter-company loans, trade credits or issuance of corporate bonds.

The trade credit information is included in the following balance sheet positions on the asset side; there are short-term account receivables (Deliverables and Services).[30]

$$TD = \frac{\text{short - term term account receivables} + \text{short - term liablities from deliveries and services}}{\text{Gross Value Added}}$$

where *i-ith* manufacturing sector, *t*-year

[30] Short-term account receivables -CSO's name "short-term assets account due and claims" and short-term account receivables (Deliverables and Services)-CSO's name "short-term assets account due and claims" for which Deliverables and Services

Then, information for internal-company loans are included in short-term accrued assets (CSO's name "short-term assets deferred expenditures"), in this case, the index is computed as a ration of short-term accrued assets to gross output as follows:

$$ICL_{i,t} = \frac{\text{Short - term accrued assets}_{i,t}}{\text{Gross Value Added}_{i,t}}$$ where *i-ith* manufacturing sector, *t*-year

The final index for the category, so-called credits and loans (CL) is defined as the sum of all indexes related to these groups; the Trade Credit Index (TD), information for internet-company loans index (ICL), and the credit and loans indexes for banking obligations (BCL1 and BCL2), is

$$CL_{i,t} = BCL1_{i,t} + BCL2_{i,t} + ICL_{i,t} + TD_{i,t}$$ where *i-ith* manufacturing sector, *t*-year

Profit Transfer Category

This third category is divided into two subcategories: visible profit transfers and invisible profit transfers. The visible profit transfers are not constructed in the CSO's Statistical Yearbook of Industry data however, it includes the data for profit transfers as part of these indicators: financial revenues on economic activity, Net financial results and retained earnings. According to the CSO's yearbook, the financial result on the economic activity is the sum of the financial results from the sale of products, goods and materials, the results on other operating activities as well as the results on financial operations.[31]

The second indicator is the retained earnings which is constructed as the net financial as the difference between gross financial results and obligatory encumbrances[32]. The

[31] According to CSO, the financial results were divided into the following categories: net sales revenues of products (goods and services), net sales revenue of goods and materials (including sums due from the sale of re-used packages other than operating revenues) and financial revenues. The other operating revenues include revenues not directly connected with the basic activity of the entity in which the following are included: profits from the sale of non-financial fixed assets, cash received free of charge including donated assets, damages and reversed provision, adjustment of depreciation value for non-financial assets, income from social activities, income from the rent or lease of fixed assets and investment in real estate. Financial revenues are considered as revenues from financial operations conducted by an entity (amounts due in respect of dividends and share in profits, interest on loans granted, interest on deposits, default interest, profits from the sale of investment, reduction of depreciation write-offs relating to investment (due to the fact that reasons resulting in the permanent loss of their value have ceased to exist), surplus of foreign exchange gains over losses.

[32] An obligatory encumbrance on gross financial results includes an income tax on legal and natural persons as well as other payments' results from separate regulations.

third variable was a net financial result for the turnover year. All these variables for visible profit transfers were expressed as a ratio of gross output to create a visible transfer index

$VP_{it} = {}^{TD_{it}}/_{Gross\ Value\ Added_{it}}$ where TD_{it} is one of the measures of visible profits for financial revenues on economic activity, Net financial results and retained earnings.

Invisible profit transfers were defined by the possible proxy expenditure on innovations (marketing) and expenditure on innovation know-how in the CSO's Statistical Yearbook of Industry data. As described earlier, the expenditure on intangible assets are one possible way for multinational companies to avoid taxations. The invisible profit indicator is described as $UP_{it} = {}^{TD_{it}}/_{Gross\ Value\ Added_{it}}$ where TD_{it} is one of the measures of invisible profits such as expenditure on innovations (marketing) and expenditure on innovation know-how. The profit transfer indicator, PT_{it} is the sum of an invisible profit transfer index, UP_{it} and a visible profit transfer index, VP_{it}. All different capital transfers, with respect to CAL, were transferred in a logarithm. The list of all CAL sector proxies is in Table 3 in Appendix 5 and these measures as denoted as $Sector\ CAL_{it}$.

It is worth noting that these proxies of CAL sector measures have certain limitations similar to capital flow indexes discussed in Chapter II. The changes in each of the proxies of CAL sector measure might include the variations in the general company performance which are caused by other factors than the CAL process. Also the CSO's Statistical Yearbook of Industry data did not provide information about inward and outward transactions with respect to the domestic and global perspective.[33] In order to measure the effect of liberalization on different industry integration, this was also computed. The

[33] In order to compute this interaction between the different directions of the company's capital flow transfers, sector dependent and on/off measure (imf_{it}) to define if country liberalized the capital flows. On/off measure is from analysis in Chapter 2. This is the standard on/off measure of CAL measures (0/1) (imf_{it}), where, in opened economies, all subcategories of capital transaction restrictions are equal to "1".

interaction is between the different directions of the company's capital flow transfers ($Sector\ CAL_{it}$) and sector dependence ($CHAT_i^k$).

5.3.3 The relationship between Sector Financial Dependence and TFP

This section describes financial dependent sector characteristics and their relation to productivity changes in order to identify financial and liquidity sector characteristics.

There are conventional methods to exploit differences in sector characteristics in the spirit of financial dependence (by Rajan and Zingales, 1998), liquidity changes (by Raddatz, 2006 and Levchenko, Ranciere and Thoenig, 2009).

Rajan and Zingales (1998) employed an analytical model that distinguished between financial dependent sectors and non-financial dependent sectors. This model uses a non-financially intensive sector by way of a control group for financially intensive sectors. The financial dependence was measured as the dependence on external finances for different companies in the sector in order to capture the share of investments that have to be financed with external funds to the firm. This measure is a ratio between the difference of capital expenditure and cash flow to capital expenditure. The argument followed in this pattern, shows that the sector that is more financially dependent will be more affected by changes in the CAL policy; because the liberalization of CAL policy would cause an increase of capital availability in the country and then through investment channels, which will lead to an expansion of productivity. On the other hand, following the path of the financial black hole discussion and animal spirits (by Tressel and Verdier, 2007), financial liberalization can increase production inefficiencies by exacerbating the misallocation of credit towards politically connected firms.

This paper, with the utilization of a similar approach to Rajan and Zingales (1998), investigates the financial dependence measure. This approach has already been used in CEE country studies on productivity (see Varela 2012). It is not possible to implement or to base this measure on the Polish CSO manufacturing data because both variables are not available in this dataset. Therefore, this paper suggests implementing measures of financial dependence that are defined as a ratio between share equity up to Gross Value

Added[34]. The idea behind this measure is that a sector, which has a higher level of initial capital, is able to obtain more external funding because companies in these sectors are also eligible to obtain higher credit ratings and convince potential investors. Therefore, this additional funding would be used as an expansion for their investment policy towards productivity, production techniques which will lead to the increase of the TFP. The logic follows, that sectors with lower ratio of share equity with respect to Gross Value Added are defined as being more financially dependent on external funding than for sectors with a higher ratio.

Companies in financially dependent sectors might not be able to achieve enough acceptable credit ranking, neither are they able to obtain funding from financial institutions, nor are they able to obtain funding through direct issue of financial assets. However, a liberalization of capital control policy may allow them to obtain access to other sources of external funding that did not exist in the domestic market before the CAL process.

Therefore, this logic shows variations in the sector data for Poland between the years 1995 and 2007 (Figure 5.2).

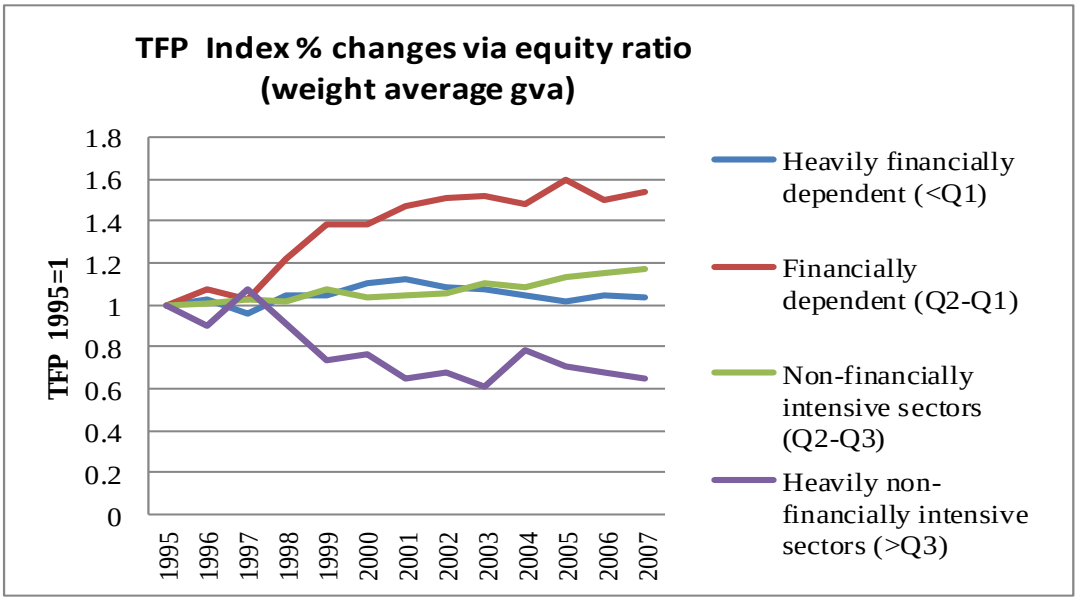
To distinguish financially dependent sectors from those non-financially dependent, the sector data is organized as follows: Firstly, percentiles (25^{th} –Q1, 50^{th} –Q2 and 75^{th} – Q3) were computed to obtain a ratio of share equity with respect to Gross Value Added for the base year of 1995. Secondly, sectors were identified as 'lower' (heavily financially dependent), if equity share ratio is below Q1. ´Upper lower´ (financially dependent,) if equity share ratio is between Q1 and Q2. ´Down up´ (non-financially intensive sectors), if an equity share ratio is between Q2 and Q3. And ´up´ (heavily non-financially intensive sectors), if an equity share ratio is above Q3.[35] Thirdly, only after grouping the various

[34] Share Equity (Equity) is defined as capital contributions declared, for the different types of FIRS it is defined differently: joint stock companies are share capital, limited liability companies are initial capital, state owned enterprises, cooperative is a participation fund and limited partnership, unlimited partnership and civil law partnership companies and finally civil law partnership companies owner's capital. Thus, Gross Value Added was implemented to normalize this data.

[35] Heavily financially dependent groups are nine: Manufacture of textiles, Manufacture of wearing apparel and furriery, Processing of leather and manufacture of leather products, Manufacture of wood, wood straw and wicker products, Publishing, printing and reproduction of recorded media, Manufacture of metal products, Manufacture of office machinery and computers, Manufacture of radio, television, communication equipment and apparatus, Manufacture of furniture, Manufacturing n.e.c. Financially

sectors according to their type of financial dependence, the arithmetic mean and weighted average mean for TFP changes were computed for each of the four groups, where the TFP in year 1995 was identified as "1". A weighted average mean was also calculated to correct for Simpson's paradox.[36] Figure 5.2 shows TFP changes, which were computed by the weight average.[37] As it was discussed in Chapter IV, TFP index is less restricted in comparison to TFP OLS and in this analysis the main focus is on TFP index.

Figure 5.2 TFP Index variation via the sector financial dependence ratio of share equity to Gross Value Added



Note: The figure is computed using weight average of Gross Value Added with year 1995 serving as the baseline. *Source*: Author's own analysis based on Polish CSO manufacturing data.

dependent sectors are two: Manufacture of rubber and plastic products, and Manufacture of medical, precision and optical instruments, watches and clocks. Non-financial dependent sectors are eight and include: Manufacture of food products and beverages, Manufacture of pulp and paper, Manufacture of other non-metallic mineral products, Manufacture of machinery and equipment n.e.c, Manufacture of electrical machinery and apparatus, Manufacture of motor vehicles, trailer and semi-trailers, Manufacture of other transport equipment and Recycling. Four sectors were defined as Heavily Non-financially dependent groups: Manufacture of tobacco products, Manufacture of coke, refined petroleum products, Manufacture of chemicals and chemical products and Manufacture of basic metals.

[36] If a computation is done using arithmetic mean then a trend appears in different sectors of data and disappears when these sectors are combined. It also works in reverse where a trend appears for the aggregate data. The weights were computed based on the value of gross output, value of gross value added and the value of revenue from total activity. All three types of measures for weight were converted into price level in 1995 in a similar way as in Chapter 4. Different weights seem to show a similar result.

[37] These calculations have been done for four different TFP approach methods.

Figure 5.2 seems to provide support for this hypothesis, that the CAL process may have had an impact according to the different types of financial dependence of the sectors. In other words, the sectors which are scarred of initial capital were the ones which were affected more through TFP growth after 1998 as financially dependent sectors. However, the heavily financially dependent sector does not show this paper. As referred to earlier, the date of liberalization of capital flows was 1998. This date was defined by the on/off capital transaction indicator ($imf_{x,t}$). It is especially visible, when viewed with respect to weight average mean calculations for TFP groups for the financially dependent sectors (for Q1-Q2). Also, the utilization of the other weights to compute mean such as revenue for total activities or Gross Value Added, does confirm the results. In this case, Rajan and Zingales' model can be implemented by non-financially intensive sectors as a control group for financially intensive sectors, which can be implemented to further estimate the analysis of the impact of the CAL process on the TFP.

Another method in the literature to find the impact of financial liberalization is through the industry–level measure of liquidity needs (see Levchenko, Ranciére and Thoenig, 2009 and Raddatz, 2006). The higher the need for liquidity, the more these sectors will be affected by the CAL process because this process allows them to obtain cheaper external funds after financial liberalization.

Raddatz (2006) defined two main measures of liquidity in which an index was defined as the ratio of inventories for a share of sales or as Cash Conversion Cycle. In the first case, the higher a fraction of inventory accumulation financed through on-going cash flow for sale is, the higher the need for liquidity. The second case presents a similar logic, the longer it takes for companies to transfer their final goods into cash, the higher the need for liquidity for the company. Thus, the sector with a longer period of cash conversion cycles will be the one which should be affected by the CAL process. Cash Conversion Cycle (CC) is a ratio that indicates the time period for which the working cycle of capital financing is needed. This ratio is measured in days, the longer the cash conversion cycle takes, the higher the investments in working capital.

This ratio has three parts: trade receivables' ratio (TR), plus Inventory turnover (IT) minus Trade payable's ratio (TP). The formula is as follows: $CC = TR + IT - TP$ where $TR = \frac{Debtors\ (Trade\ receivables) * 365}{Credits\ Sale\ (Sales)}$, $IT = \frac{Inventory * 365}{Cost\ of\ Sales}$ and $TP = \frac{Trade\ credits * 365}{Cost\ of\ Sales}$.[38]

Figure 5.3 TFP Index variation via sector liquidity dependence -Ratio of inventories to sales (weight average GVA)

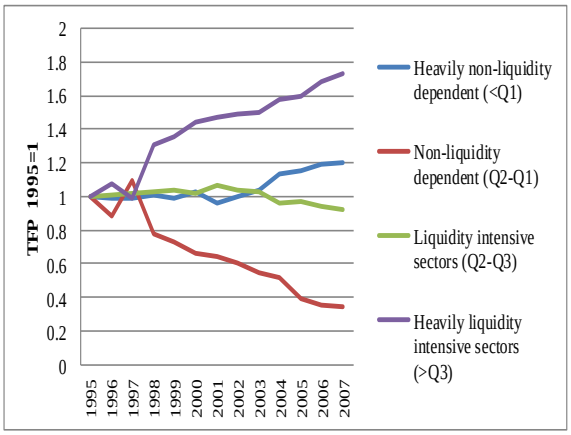
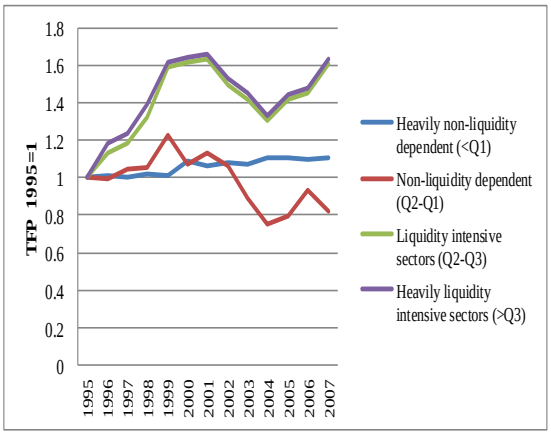


Figure 5.4 TFP Index variation via sector liquidity dependence -Cash Conversion Cycle (CC) (weight average GVA)



Note: The figure is computed using weight average of Gross Value Added with year 1995 serving as the baseline. Source: Author's own analysis based on Polish CSO manufacturing data.

Both measures of liquidity identify a higher need for liquidity as the value of the indexes gets higher. In this case, sector groups are computed using percentiles (25th – Q1, 50th –Q2 and 75th –Q3). A lower 25th percentile is defined as a heavily non-liquidity dependent sector, if the liquidity measure is below Q1. Upper lower is a non-liquidity dependent sector, if the index is between Q1 and Q2. Down up (liquidity intensive sectors), if an index is between Q2 and Q3. And up - (heavily liquidity intensive sectors), if an index is above Q3.[39] The figures show that heavily liquidity intensive sectors were

[38]Measure of liquidity by Raddatz (2006) was computed in CSO's dataset as ratio of Inventories in Current Assets/ Revenue from selling final goods. On the other hand, Cash Conversion Cycle was defined through (TR= 365 times a ratio of Short-term Account Receivables- deliveries and services and Revenue for selling final goods, IT= 365 times and ratio of Inventories-Current Assets and Cost from producing sold final products, TP= 365 times ration of Short-term liabilities, deliveries and services and Cost from producing sold final products).

[39] Liquidity measures as a ratio of inventory to sale: Heavily liquidity dependent group: Manufacturers of furniture, manufacturing n.e.c, Manufacturers of textiles, Manufacturers of radio, television and communication equipment and apparatus, Manufacturers of medical, precision and optical instrument, watches and clocks, Manufacturers of machinery and equipment n.e.c, Manufacturers of office machinery and computers and Manufacturers of other transport equipment, Liquidity dependent sectors: Manufacturers of wood and wood, straw and wicker products, Manufacturers of chemicals and chemical products, Manufacturers of wearing apparel and furriery, Manufacturers of electrical

affected through the liberalization of capital flows in 1998 and then, in 2004, according to both measures of liquidity. With regards to Cash Conversion Cycle, it seems that liquidity intensive sectors with a longer period of converting final products into cash have noticed a similar pattern as the sector above (Q3). However, this result is not confirmed for heavily liquidity dependent sector.

The results from analysing both types of measures (financial dependence and liquidity dependence) regarding TFP changes, suggest that the CAL has some impacts via different sectors' dependence on productivity changes however, they are not conclusive. The mixed evidence shown in figures 5.3 and 5.4 could be further investigated by using regressions. Furthermore, the analysis of sector dependence enables the definition of switcher indicators to indicate this financial and liquidity sector characteristic ($CHAT_i^k$). The list of sector dependence characteristics variables is shown in Table 2 of Appendix 5.

5.3.4: The reason for this empirical methodology strategy

The empirical methodology first follows the theoretical frameworks by Griliches-Lichtenberg (1984), Rodrik (1998), Edward's model (2001) and then it follows Arteta,

machinery and apparatus, Manufacturers of metal products, Processing of leather and manufacturers of leather products and Manufacturers of motor vehicles, trailer and semi-trailers. Non-liquidity dependent sectors: Manufacturers of pulp and paper, Manufacturers of rubber and plastic products, Manufacturers of other non-metallic mineral products, Manufacturers of basic metals and Manufacturers of food products and beverages, Heavily non- liquidity dependent groups: Manufacturers of coke, refined petroleum products, Recycling and Publishing, printing and reproduction of recorded media. Cash Conversion Cycle (CC) measures Heavily liquidity dependent group: Manufacturers of radio, television and communication equipment and apparatus and Manufacturers of office machinery and computers, Liquidity dependent sectors: Manufacturers of motor vehicles, trailer and semi-trailers, Manufacturers of other transport equipment, Manufacturers of machinery and equipment n.e.c and Manufacturers of medical, precision and optical instrument, watches and clocks, Non-liquidity dependent sectors: Recycling, Manufacturers of electrical machinery and apparatus, Manufacturers of furniture, manufacturing n.e.c and Manufacturers of metal products Heavily non-liquidity dependent groups: Manufacturers of coke, refined petroleum products, Manufacturers of tobacco products, Manufacturers of food products and beverages, Manufacturers of wood and wood, straw and wicker products, Manufacturers of other non-metallic mineral products, Manufacturers of chemicals and chemical products, Processing of leather and manufacturers of leather products, Manufacturers of rubber and plastic products, Manufacturers of pulp and paper, Publishing, printing and reproduction of recorded media, Manufacturers of basic metals, Manufacturers of wearing apparel and furriery, Manufacturers of textiles.

Eichengreen and Wyplosz (2001), Meyer-Sinani (2002, 2004). The theoretical discussion points out that there is a "positive" channel that increases productivity growth through allocative efficiency as an effect of CAL. This causes an improvement of macroeconomic-political reforms and proper sequence of CAL reforms. Then, there is a "negative" channel showing negative impact on productivity. Namely, a CAL event can reduce production efficiency since less efficient companies could benefit through a reduction of cost and capital creating a financial black hole in which unproductive projects are funded (dissected in the theoretical paper by Ranciere and Tornell, 2011).

Moreover, macroeconomic empirical analyses by Rodrick (1998) and others, Arteta, Eichengreen, and Wyplosz (2001), Meyer-Sinani (2002, 2004) did not find conclusive answers to these theoretical discussions. The dependent variable was economic growth and the variables of interest were measured by several De-facto and De-jure CAL measures.

Next, the empirical discussion moved into less level aggregated data for the adaptation of manufacturing industries. Pioneers of this discussion were Rajan and Zingales (1998). They employed a model that distinguishes between financial dependence sectors and non-financial dependence sectors. In the model, the financial dependence was measured as the sector dependence on external finances for different companies in the sector to find out what share of investments is financed with external funds; the explanatory variable was output growth. The changes in output were analysed with respect to the interaction between an industry financial dependence and country–level measure of financial development. The financial development was a sum of domestic credits and stock market capitulation as ratio to Gross Domestic Product.

Continuing the sector-level research and building on Rajan and Zingale's (1998) methodology, Raddatz (2006) identified a causal link between liberalization, sector liquidity dependence and output volatility. In this paper, Raddatz built a measure of liquidity needs based on inventory ratio and the cash conversion cycle to test the hypothesis that financial development leads to a relatively larger reduction in the volatility of industries with higher liquidity needs. Similarly to Rajan and Zingales' (1998) methodology, the interaction between sector liquidity characteristics and financial development was examined as the parameter of interest and financial development was

captured by the level of private credit to GDP. Both analyses by Raddatz' (2006) and Rajan and Zingales' (1998) adopted US manufacturing data. Levchenko, Ranciere, and Thoening (2007) progressed this research into cross-country sector analysis adopting the same line of research.

Levchenko, Ranciere, and Thoening (2007) investigated the impact of liberalization on productivity, volatility of production and other sector characteristics using both de facto and de jure measures of liberalization. In Levchenko, Ranciere, and Thoening's (2007) paper, de facto measures of capital account liberalization was defined as the interaction between capital flows measure from Lane and Milesi-Ferretti (2006) and the financial differences in sector characteristic in the spirit of Rajan and Zingales' (1998) paper. All of these manufacturing industry analysis of financial liberalization employed a set of Difference-in-Differences estimates strategy.

Therefore, this paper will apply this approach in order analyse these possible impacts on the Polish manufacturing sector.

5.3.5 Estimation Strategy

This section investigates and identifies whether there is a causal link between CAL and productivity. It analyses the channels through which CAL may impact on productivity in the spirit of Rajan and Zingales (1998) and Raddatz (2006). The first hypothesis is that industries that are more dependent on external financing may have higher growth rates in Poland after the liberalization of capital flows. The second hypothesis is related to the empirical literature that there is a non-conclusive effect of CAL effect on the performance of manufacturing sectors. As discussed in Section 5.2, those effects occur as the liberation impacts through different capital transmission mechanisms such as deposits and securities channels, credits and loans transactions and lastly profits channels.

In order to answer the hypotheses the following methodology with two parts was employed: standard sector financial dependence productivity estimation strategy (Model 1a), and an alternative CAL sector productivity estimation strategy (Model 1b).

In light of the empirical literature, each of these models were estimated by the Difference-in-Differences estimation. In this model, the estimation outcomes can be observed for two different manufacturing sectors for two time periods, one period is before CAL and the second period after it. In this case, financial and liquidity dependent sectors are exposed to a treatment of CAL in the second period, but not in the first period. Non-financial and non-liquidity dependent sectors are not exposed to the CAL treatment during either period. If the same units within a sector are observed over the years, the average gain in the non-financial or liquidity dependent sectors is subtracted from the average gain in the financial or liquidity dependence sectors.

An employment of Differences in Difference estimation will allow to remove biases in the CAL period comparisons between financial or liquidity dependent, and non-financial or non-liquidity dependent sectors, that could be the result from permanent differences between two different type of sectors, as well as biases from comparisons over time in the financial dependent sector, that could be the result of trends. Moreover, in order to overcome omitted variable concerns, it is necessary to employ Difference-in-Differences estimation strategies following Rajan and Zingales' (1998), Raddatz' (2006) and Levchenko, Ranciere, and Thoening (2007).

In order to find the answer to this CAL impact through financial dependence, the financial dependent productivity estimation strategy (Model 1a) was adopted to define country CAL differences influence on productivity. In order to make a prediction about country liberalization differences, between industries based on an interaction and between a country and industry characteristic, which follows the way of previous studies such as Rajan and Zingales' (1998) and Raddatz' (2006). We estimate the following specification in the panel of sectors and time:

$$TFP_{it} = \beta_0 + \beta_1 imf_t + \beta_2 CHAT_i^k + \beta_3 CHAT_i^k * imf_t + \gamma X_{it} + \varepsilon_{it} \qquad (1a)$$

where –t-time unit, i-sector unit, k is defined as Finance, Liquidity I and II, ε-error terms

On the left-hand side, the dependent variable of total factor productivity (TFP_{it}) in industry j over the period between 1995 and 2007, which is measured by the non-parametric approach, Hicks-Moorsteen Index (TFP index) and the parametric approach of OLS estimation of TFP (TFP OLS). The left-hand side variables are measures for over a

period of time from 1996 to 2007 for 22 manufacturing sectors. The vector of control variables X_{it} contains the last year share of the sector in total fixed asset investments $INVESTMENT_{i,t-1}$, as well as the beginning-of-a period of openness variable $OPENNESS_{i,t}$ is the sum of exports and imports as a share of the gross output in the sector.[40]

The selection of control variables was done on the basis of existing literature such as human capital index, concentration index, and percentage changes in exports or imports. However, these other independent variables apart from investment and openness variables were not statistically significant in the empirical analysis. Both investment and openness variables have endogeneity character, it is not possible to totally control this, but it can be captured partially by lagged variables.

De facto CAL measure (imf_t) is a binary measure (0/1) that the liberalization event is dated for the country and then compared. De facto measure of CAL is the most standard in the empirical literature. Compared to de jure measure it is suspect to less endogeneity problems as the measure construction is based on the legal regulations changes, then in actual changes in capital flows or interest rates. The parameter of interest is β_3, or the effect of the interaction of de Facto CAL measure (imf_t) and sector financial and liquidity dependence $(CHAT_i^k)$. This empirical estimation strategy relies on the two variations of financial and liquidity dependence variables $(CHAT_i^k)$.

A first variation of these variables is on/off sector-level where "1" indicates financial/liquidity dependence sectors and otherwise "0" is non-financial/non-liquidity dependence sectors that are based on the financial/liquidity ratio with respect to the median of this ratio.

A second variation is the value of each financial/liquidity ratio at the level of the year 1995. The financial sector dependence variable $(CHAT_i^{Finance})$ was built based on the

[40] In this estimation model, we have also used different lags of investments and openness variables, but these variables were not statistically significant. Moreover, other variables were also included in the estimation, such as the sectoral concentration index, the ratio of privatized companies to the total number of companies in this sector, used as measure for privatizations. Also, these variables were not statistically significant for this estimation period. In order to analyse European integration, a dummy variable (0/1) was added into the estimation, where '1' is after the year 2004 Poland jointed the EU, and then '0' is before the year 2004. Again, this variable did not provide any statistically significant results.

financial ratio as share equity to Gross Value Added. Then, liquidity sector dependence variables were defined based on two liquidity ratios, the first variable ($CHAT_i^{Liquidity\ I}$) is Cash Conversion Cycle (CC) and the second variable ($CHAT_i^{Liquidity\ II}$) is the inventory ratio to sales. All specifications include a set of fixed effects (sector effect, time effect and sector x time effects).The fixed effects significantly improve in alleviating simultaneity issues by controlling omitted variable.

An alternative approach is to analyse the effect of financial liberalization on productivity through various capital transmission mechanisms (Model 1b). We employ empirical strategies parallel to the standard sector financial depended productivity estimation strategy mentioned above. As Levchenko et al. points out, it does not allow for researchers to identify the magnitude and direction of the overall effect of financial liberalization. This alternative CAL sector productivity estimation strategy (Model 1b), which is included in the equation, is the treatment effect (sector) level and interaction with the treatment effect on country level and industrial financial dependence. In particular, this is the following set of estimation specifications:

$$TFP_{it} = \beta_0 + \beta_1 * imf_t + \beta_2 CHAT_i^k + \beta_3 * \ CAL\ Sector_{it} + \beta_4 CHAT_i^k * CAL\ Sector_{it} + \gamma X_{it} + \ \varepsilon_{it} \quad (1b)$$

where –t-time unit, i-sector unit, k is defined as Finance, Liquidity I and II, ε-error terms

In this specification, defined is the period of liberalization for Poland by the usage of on-off measures (imf_t). The variable imf_t takes the value of '0' before the liberalization episode, and '1' after it. This variable indicates whether the observation is from before or after treatment as this liberalization policy. Then, following Raja-Zingales and the Raddatz-type model, non-financially and non-liquidity intensive sectors are used as a control group compared to the financially and liquidity intensive sectors. Similar to Model (1b) we use the same vector as control variable X_{it} as in Model (1a), this contains the last year share of the sector as total fixed asset investments $INVESTMENT_{i,t-1}$, as well as the beginning-of-a period of openness variable $OPENNESS_{i,t}$ is the sum of exports and imports as a share of the gross output in the sector. The coefficient of interest β_4 is the variable, which is defined as interaction of the proxy of CAL sector

measure ($CAL\ Sector_{it}$) and sector financial and liquidity dependence ($CHAT_i^k$). This coefficient describes if the changes in the productivity of sectors with high liquidity needs or financial dependence were caused as the results of changes in each of the capital transmission mechanisms after the CAL on the country level, then β_4 can be 'positive' or 'negative' and economically significant. This empirical strategy is similar in a certain way to Lenchenko, Ranciere and Thoening's (2006) approaches, with respect to their analysis of the impact of De jure CAL measure on output.

All specifications include a set of fixed effects (sector, time effects and sector x time effects) to alleviate simultaneity issues by controlling omitted variables. This also investigates the accuracy of the CAL sector measures approach ($CAL\ Sector_{it}$) compared to the CAL country index (imf_t) in order to see if this methodology provided an advantage to correct the omitted variable problem, due to its inability to include sector and time effects in capital control estimations.

As mentioned above, this methodology aims to identify the effect of CAL from differential effect across industries in Poland and to identify through which channels this effect happens. However, this methodology does not allow for the magnitude of the overall effect of this liberalization on productivity.

5.4. Empirical Results

One of the hypothesis of this paper is that industries that are more dependent on external financing and with more requirements for liquidity will increase productivity as a result of the liberalization of capital and current accounts in balance payments. In order to investigate this hypothesis, the empirical results of Difference in Differences estimations were presented in Tables 5.3-5.6. These tables analyse the impact of Capital Account Liberalization on productivity through sector financial and liquidity dependences. The reported standard errors are heteroscedasticity corrected in all results tables.

Tables 5.3-5.6 report the results of estimating equations (1a), where the dependent variable is defined as total factor productivity in a sector over the period between 1996 and 2007 and the independent variable of interest, $imf_t * CHAT_i^k$, is the interaction

between country CAL characteristics (imf_t) and financial dependence industry characteristic ($CHAT_i^k$).

The independent variables of interest were categorised in two types as dummy variables presented in tables 5.3 and 5.4 and then as a continuous value of financial dependence indexes at the level of the year 1995, which was shown in tables 5.5 and 5.6. These continuous financial dependence variables were included in order to obtain more information of industry characteristics, as a dummy variable is more restricted. Moreover, each type of financial dependence industry characteristics variables were built based on three main financial dependence indexes such as, a ratio of share equity, an inventory to sales ratios and a cash conversion cycle (CC) of which the results are shown in three main sections in each table below. This colour codding was adopted to simplify the tables below.

The ratio of share equity was defined as 'blue' in the table below and lower ratio of share equity to Gross Value Added in the sector are defined as more financially dependent of the external funding sector. The companies in these sectors were unable to achieve a good credit rating, as then obtain funding from financial intermediaries via direct or indirect financing. Another two financial dependence indexes measure the level of liquidity needs and short-run external liquidity dependence, the first one inventory to sale ratios is indicated as 'yellow' in the table below, which measures the ability of a firm to finance its on-going cost of storing inventories from its sale revenues. And the second index is the cash conversion cycle indicated as 'green' in the table below, which estimates the number of days between the moment a firm pays for its raw materials and the moment it is paid for by the sale of final products during it's normal course of operations (see Raddatz 2005). The higher the value of this liquidity index, the more financial depended is this sector.

The augmenting regressions were estimated in relating to two TFP measures: parametric (TFP OLS) and nonparametric approach (TFP index). TPF OLS is shown in tables 5.3 and 5.5 and TPF index in tables 5.4 and 5.6. Each table from 5.3 to 5.6 has three columns added progressively, more fixed effects and control variables, and the first column uses time effect. Column 2 adds a control variables and Column 3 includes sector effects. Several characteristics of this specification such as inclusion of industry

and yearly specific effect were to control for any determinant of productivity and country environment that varies across time or industries (for instance, inflation, terms of trade volatility, sector concentration, etc.) and they significantly reduce the concerns about omitted variable bias. As can be seen in tables 5.3 to 5.6, the coefficient estimation for country characteristics (imf_t) is positive and statistically significant for at least in the 10% level. This coefficient suggests, that the aggregate change in TFP between the pre and post liberalization years, show an increase in the manufacturing sector which is between 16 and 45 percentage points across different measures. Therefore, it seems that across-differential model specifications, country specific and interaction variables are stable.

In this specification in Model (1a), CAL country characteristics (imf_t) are interacted with financial dependence on external finance and liquidity needs that has the coefficient on this interaction term which is positively statistically significant at least at the 10% level across different TFP measures. It seems to be the case that as a result, Poland liberalized the capital account transaction to more financially and liquidity dependent sectors benefiting in high productivity than to less dependent sectors. These results also seem to be consistent across different financial dependent characteristics and productivity measures, except from results for a continuous liquidity dependent characteristics measure based on inventory ratio at the level of the year 1995 for TFP OLS measure which shows a strong negative impact (see Table 5.6). This difference in the coefficient in Table 5.6 might be driven by the restriction of the parametric TFP measure. The parametric TFP OLS measure is more restricted in comparison to the TFP index. For instance, the parametric TFP OLS measure assumes that there is constant share of labour and capital in the calculation over time. As the years between 1996 and 2007 represent the intensive period of transformation in Polish economy, this assumption of constant share does not seem to be accurate to further this analysis. Given this restriction of parametric TFP measure, TFP index is more suited for the further analysis.

Moreover, the results presented in Tables 5.3 to 5.4 suggest that the effect of post liberalization of capital account transaction was stronger with positive effect on productivity in sector liquidity dependence for longer periods of transferring raw

materials for final products into cash payments, for these products, 8 percentage points than in the financial dependence sector measured by share of equity. Industries that have considerable dependence on external finances have increased productivity (+17%) although this is only borderline statistically significant at 10 percentage points.

Furthermore, there is evidence that the smaller effect in productivity was observed in sector liquidity dependent, with higher value of inventory to sale ratio, as results show de facto CAL in Poland (see tables 5.3 to 5.6). In Table 5.3, it is seen that more liquidity dependent sectors experience a higher productivity by 25 percentage points. These results confirm the existence of allocative efficiency effect on growth that the reduction in capital control provides improvements in investment and savings conditions; which can be directly linked with the decrease of cost for capital and increase the efficiency of investment portfolio diversification (see Claessens, 1993). Moreover, the removal of these capital regulation distortions allows for capital to be redeployed from low to higher marginal productivity uses leading to higher economic growth (Stiglitz and Charlton, 2004, Dollar and Kray 2001).

To summarize these results in three main points: first, there is statistical significant positive effect on productivity in financial and liquidity dependent sectors after the liberalization. Second, this result also confirms that continuous financial and liquidity dependence provides weak evidence of this liberalization impact on productivity. Third, given strong restriction of parametric TFP measure, it is preferable to use the TFP index measure for further analysis in this chapter.

Table 5:3: Financial Sector Dependence (on/off), De Facto CAL measures and TFP Index Difference-in-Differences Results

	TFP Index				TFP Index				TFP Index		
	(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
IMF(t)	0.171	0.387**	0.357**	IMF(t)	0.190	0.384***	0.377***	IMF(t)	0.097	0.307	0.351**
	(0.149)	(0.129)	(0.113)		(0.125)	(0.111)	(0.101)		(0.182)	(0.167)	(0.118)
Chat Finance(t)	0.223*	-0.110	-0.491*	Chat Liquidity I (t)	0.365***	-0.014	-0.192	Chat Liquidity II (t)	0.317*	-0.030	1.531**
	(0.109)	(0.105)	(0.240)		(0.093)	(0.102)	(0.351)		(0.137)	(0.134)	(0.545)
IMF *Chat Finance(t)	0.163	0.164	0.159*	IMF *Chat Liquidity I (t)	0.231	0.239*	0.224**	IMF *Chat Liquidity II (t)	0.228	0.212	0.086
	(0.136)	(0.123)	(0.073)		(0.124)	(0.119)	(0.085)		(0.169)	(0.157)	(0.087)
Log of Investment / GVA (t-1)		-4.704***	-3.633	Log of Investment / GVA (t-1)		-4.387***	-3.700	Log of Investment / GVA (t-1)		-4.319***	-0.049
		(0.573)	(1.886)			(0.527)	(1.892)			(0.522)	(1.936)
Openness		1.729***	1.956**	Openness		1.394***	1.933**	Openness		1.569***	5.922***
		(0.319)	(0.656)			(0.342)	(0.659)			(0.334)	(1.592)
Constant	1.511***	-0.037	-0.436	Constant	1.523***	0.446	-0.387	Constant	1.407***	0.103	-9.284**
	(0.103)	(0.701)	(0.913)		(0.082)	(0.677)	(0.913)		(0.136)	(0.648)	(3.078)
Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes
Sector Effect	no	no	yes	Sector Effect	no	no	yes	Sector Effect	no	no	yes
N	264	264	264	N	264	264	264	N	264	264	264
R-sq	0.162	0.420	0.758	R-sq	0.244	0.433	0.759	R-sq	0.228	0.430	0.790
AIC	465.514	372.604	179.506	AIC	438.487	366.226	178.034	AIC	444.033	368.043	143.944
BIC	515.577	429.819	304.665	BIC	488.550	423.441	303.193	BIC	494.096	425.258	272.678

Notes: Robust standard errors in brackets; * p<0.05, ** p<0.01, *** p<0.001-reject the Null hypothesis. The sample is a panel for the period between 1996 and 2007. The dependent variable is the TFP Index based on the Gross Value Added. IMF is on/off CAL measure on the country level, Log of Investment/GVA is the log of Investments on fixed assets per Gross Value Added in sector over time, Openness is log of the sum of export and import per Gross Value Added, Chat Finance- is on/off sector-level measure of reliance on financial dependence with respect to share equity, Chat Liquidity I is on/off sector-level measure of liquidity needs based on Cash Conversions Cycle, and Chat Liquidity II is on/off sector-level measure of liquidity based on inventory ratio. *Source:* Polish CSO's manufacturing sector data.

Table 5.4: Financial Sector Dependence (on/off), De Facto CAL measures and TFP OLS Difference-in-Differences Results.

	TFP OLS				TFP OLS				TFP OLS		
	(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
IMF(t)	0.198*	0.240**	0.073	IMF(t)	0.120	0.139	-0.003	IMF(t)	0.164	**0.231***	-0.010
	(0.094)	(0.091)	(0.063)		(0.098)	(0.093)	(0.055)		(0.128)	(0.114)	(0.067)
Chat Finance(t)	0.148	0.061	0.630***	Chat Liquidity I (t)	-0.022	-0.013	0.402*	Chat Liquidity II (t)	-0.064	-0.194	-0.948***
	(0.094)	(0.095)	(0.145)		(0.117)	(0.101)	(0.182)		(0.104)	(0.103)	(0.280)
IMF *Chat Finance(t)	-0.019	-0.012	-0.011	IMF *Chat Liquidity I (t)	0.250	0.273*	0.271***	IMF *Chat Liquidity II (t)	0.035	0.050	**0.131***
	(0.105)	(0.101)	(0.064)		(0.131)	(0.109)	(0.059)		(0.115)	(0.105)	(0.064)
Log of Investment / GVA (t-1)		-1.480**	1.969*	Log of Investment / GVA (t-1)		-1.210**	1.850*	Log of Investment / GVA (t-1)		-2.237***	0.124
		(0.568)	(0.848)			(0.455)	(0.821)			(0.532)	(0.826)
Openness		-0.334	-1.859***	Openness		-0.719**	-1.908***	Openness		-0.156	-3.999***
		(0.204)	(0.485)			(0.252)	(0.466)			(0.231)	(0.844)
Constant	2.776***	3.968***	5.158***	Constant	2.856***	4.650***	5.350***	Constant	2.894***	4.047***	9.955***
	(0.062)	(0.494)	(0.779)		(0.067)	(0.520)	(0.754)		(0.103)	(0.474)	(1.590)
Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes
Sector Effect	no	no	yes	Sector Effect	no	no	yes	Sector Effect	no	no	yes
N	264	264	264	N	264	264	264	N	264	264	264
R-sq	0.193	0.241	0.811	R-sq	0.224	0.297	0.825	R-sq	0.164	0.265	0.835
AIC	195.980	183.901	-144.684	AIC	185.703	163.701	-165.952	AIC	205.521	175.486	-178.316
BIC	246.043	241.116	-19.526	BIC	235.766	220.917	-40.793	BIC	255.584	232.701	-49.581

Notes: Robust standard errors in brackets; * p<0.05, ** p<0.01, *** p<0.001-reject the Null. The sample is a panel for period between 1996 and 2007. The dependent variable is the parametric measures TFP OLS based on the Gross Value Added. IMF is on/off CAL measure on the country level, Log of Investment/GVA is the log of Investments on fixed assets per Gross Value Added in sector over time, Openness is log of the sum of export and import per Gross Value Added, Chat Finance- is on/off sector-level measure of reliance on financial dependence with respect to share equity, Chat Liquidity I is on/off sector-level measure of liquidity needs based on Cash Conversions Cycle, and Chat Liquidity II is on/off sector-level measure of liquidity based on inventory ratio. *Source:* Polish CSO's manufacturing sector data.

Table 5.5: Financial Sector Dependence (continuous), De Facto CAL measures and TFP Index Difference-in-Differences Results

	TFP Index				TFP Index				TFP Index		
	(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
IMF(t)	0.368*	0.430**	0.304**	IMF(t)	-0.162	-0.042	-0.125	IMF(t)	0.351	0.524***	0.473***
	(0.159)	(0.160)	(0.107)		(0.195)	(0.161)	(0.088)		(0.184)	(0.148)	(0.124)
Chat Finance(t)	-0.295**	-0.041	2.427***	Chat Liquidity I (t)	0.001*	-0.001*	-0.065***	Chat Liquidity II (t)	-1.820**	-0.818	-25.364**
	(0.111)	(0.126)	(0.695)		(0.001)	(0.001)	(0.018)		(0.558)	(0.477)	(7.685)
IMF *Chat Finance(t)	-0.175	-0.174	-0.116	IMF *Chat Liquidity I (t)	0.002**	0.002**	0.002***	IMF *Chat Liquidity II (t)	-0.557	-0.337	-0.364
	(0.140)	(0.149)	(0.070)		(0.001)	(0.001)	(0.000)		(0.716)	(0.582)	(0.390)
Log of Investment / GVA (t-1)		-3.908***	-0.097	Log of Investment / GVA (t-1)		-4.500***	0.500	Log of Investment / GVA (t-1)		-4.649***	0.072
		(0.548)	(1.905)			(0.617)	(1.883)			(0.524)	(1.926)
Openness		1.553***	5.932***	Openness		1.672***	5.865***	Openness		1.625***	6.043***
		(0.334)	(1.548)			(0.313)	(1.505)			(0.322)	(1.525)
Constant	2.028***	0.217	-11.918**	Constant	1.488***	0.350	-2.069	Constant	1.944***	0.232	-4.144**
	(0.108)	(0.699)	(3.726)		(0.151)	(0.670)	(1.073)		(0.130)	(0.690)	(1.420)
Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes
Sector Effect	no	no	yes	Sector Effect	no	no	yes	Sector Effect	no	no	yes
N	264	264	264	N	264	264	264	N	264	264	264
R-sq	0.266	0.445	0.791	R-sq	0.268	0.426	0.798	R-sq	0.131	0.430	0.790
AIC	430.760	360.651	142.399	AIC	429.994	369.569	133.458	AIC	475.174	367.941	144.421
BIC	480.823	417.866	271.133	BIC	480.057	426.785	262.192	BIC	525.238	425.156	273.155

Notes: Robust standard errors in brackets; * p<0.05, ** p<0.01, *** p<0.001-reject the Null hypothesis. The sample is a panel for the period between 1996 and 2007. The dependent variable is the parametric measures TFP Index based on the Gross Value Added. IMF is on/off CAL measure on the country level, Log of Investment/GVA is the log of Investments on fixed assets per Gross Value Added in sector over time, Openness is log of the sum of export and import per Gross Value Added, Chat Finance- is a sector-level measure of reliance on financial dependence with respect to share equity at the level of year 1995, Chat Liquidity I is a sector-level measure of liquidity needs based on Cash Conversions Cycle at the level of year 1995, and Chat Liquidity II is a sector-level measure of liquidity based on inventory ratio at the level of year 1995. *Source:* Polish CSO's manufacturing sector data.

Table 5.6: Financial Sector Dependence (continuous), De Facto CAL measures and TFP OLS Difference-in-Differences Results

	TFP OLS				TFP OLS				TFP OLS		
	(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
IMF(t)	0.117	0.158	0.156*	IMF(t)	-0.107	-0.107	-0.156	IMF(t)	0.342*	0.382**	0.253**
	(0.135)	(0.137)	(0.075)		(0.200)	(0.182)	(0.105)		(0.158)	(0.140)	(0.078)
Chat Finance(t)	-0.043	0.044	-1.119**	Chat Liquidity I (t)	0.000	0.000	0.029**	Chat Liquidity II (t)	-0.078	-0.024	13.005**
	(0.092)	(0.093)	(0.371)		(0.001)	(0.001)	(0.010)		(0.496)	(0.462)	(4.025)
IMF *Chat Finance(t)	-0.006	-0.016	-0.043	IMF *Chat Liquidity I (t)	0.001	0.001	0.002**	IMF *Chat Liquidity II (t)	-0.871	-0.826	-1.008**
	(0.103)	(0.101)	(0.065)		(0.001)	(0.001)	(0.001)		(0.567)	(0.517)	(0.331)
Log of Investment / GVA (t-1)		-1.857***	0.197	Log of Investment / GVA (t-1)		-0.240	0.658	Log of Investment / GVA (t-1)		-1.593**	0.360
		(0.541)	(0.829)			(0.568)	(0.813)			(0.490)	(0.815)
Openness		-0.289	-3.842***	Openness		-0.633**	-3.964***	Openness		-0.394	-3.834***
		(0.208)	(0.837)			(0.211)	(0.832)			(0.221)	(0.828)
Constant	2.974***	4.100***	10.846***	Constant	2.882***	4.147***	6.429***	Constant	2.863***	4.157***	6.722***
	(0.103)	(0.476)	(1.934)		(0.176)	(0.450)	(0.784)		(0.131)	(0.509)	(0.918)
Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes	Yearly Effect	yes	yes	yes
Sector Effect	no	no	yes	Sector Effect	no	no	yes	Sector Effect	no	no	yes
N	264	264	264	N	264	264	264	N	264	264	264
R-sq	0.167	0.240	0.832	R-sq	0.279	0.313	0.849	R-sq	0.184	0.255	0.835
AIC	204.345	184.448	-173.692	AIC	166.411	157.560	-202.535	AIC	198.960	179.023	-179.351
BIC	254.409	241.663	-44.958	BIC	216.474	214.775	-73.801	BIC	249.023	236.238	-50.617

Notes: Robust standard errors in brackets; * p<0.05, ** p<0.01, *** p<0.001-reject the Null hypothesis. The sample is a panel for the period between 1996 and 2007. The dependent variable is the parametric measures TFP OLS based on the Gross Value Added. IMF is on/off CAL measure on the country level, Log of Investment/GVA is the log of Investments on fixed assets per Gross Value Added in sector over time, Openness is log of the sum of export and import per Gross Value Added, Chat Finance- is a sector-level measure of reliance on financial dependence with respect to share equity at the level of year 1995, Chat Liquidity I is a sector-level measure of liquidity needs based on Cash Conversions Cycle at the level of year 1995, and Chat Liquidity II is a sector-level measure of liquidity based on inventory ratio at the level of year 1995. *Source:* Polish CSO's manufacturing sector data.

The empirical results from tables 5.3 to 5.6 are as expected and are consistent with findings from the same line of research including those of Rajan and Zingales (1998), Raddatz (2006) and Levchennko, Ranciere and Thoening (2007). However, these studies investigated the impact of sector financial dependence on output growth and the volatility of outputs. These empirical studies also found that there is a positive impact of financial liberalization, on an increase in the output of more financial and liquidity dependent sectors.

As the result of limits in Polish manufacturing data availability and main event CAL process happened in 1998, it was not possible to compare the impact of this sectors financial dependence on TFP growth by implementation of new intensive measure of CAL process which were described in Chapter 2. As it can be seen, there is a statistically significant effect of liberalization on productivity via industry characteristics variables. Also above we did not investigate each capital transmission mechanism of inflow and outflows that would impact on the manufacturing sector production.

As it was discussed in section 5.2, we adopt the proxy CAL sector measures ($CAL\ \ Sector_{it}$), which are specifically used to address the key interest of the research question and is determined by availability in the dataset. The capital transmission mechanisms, so-called proxy of CAL sector measures, are divide into three channels: 1) deposits and securities transactions 2) loans, credits and debt transactions and 3) profit transfers.

The first group, deposits and securities transactions, is specified as share capital. The share capital is defined as the sum of nominal value of the company's shares multiplied by the number of its included shared premium.

The second group, credits and loans transactions, is defined by five indicators which are long-term liability credits and loans ($BCL1/GVA_{it}$), short-term liability credits and loans ($BCL2/GVA_{it}$), trade credits (TD/GVA_{it}), internet company loans index (ICL/GVA_{it}) and Credit and loans index (CL/GVA_{it}). The credit and loans index is a sum of long-term liability credits and loans ($BCL1/GVA_{it}$), short-term liability credits and loans ($BCL2/GVA_{it}$), trade credits (TD/GVA_{it}) and Internet company loans index (ICL/GVA_{it}).

The third group, profit transfers, is divided into two categories: visible and invisible profit transfers. Visible profit transfers as a ratio of GVA is defined by three possible proxies, Financial Revenues on Economy Activities ($VP1/GVA_{it}$), Net Financial Results ($VP2/GVA_{it}$) and Retained Earnings ($VP3/GVA_{it}$). Invisible profit transfers are illuminated as ratio of expenditure on innovations to Gross Value Added ($UP1/GVA_{it}$), and a ratio of expenditure on innovation know-how to Gross Value Added ($UP2/GVA_{it}$). All proxies for the CAL measures are expected in logarithmic form.

Next, we analyse the impact of proxy CAL sector measures and its interactions with financial industry characteristics on the productivity. This enables correction for the country liberalization effect and industry characteristics in the same way as previous studies have, Rajan and Zingales (1998) and Levchenko, Ranciere and Thoenig (2007). The most effective approach of correcting for the liberalization process and industry characteristics is to use indicator variables, one for each country liberalization specific (imf_t), and another for industry ($CHAT_i^k$). Then, it is also important to analyse proxies for sector CAL measures in order to investigate by which transmission mechanism the CAL process can affect the firms operations and the productions of final products.

In Section 5.3, the transmission capital flow channels were described to identify proxies for CAL sector-level measures as denoted $CAL\ \ Sector\ _{it}$. These proxies were divided into three groups; Securities and Deposits transactions, Credits and Loans transactions and Profit transfer transactions.

Due to the aforementioned Polish manufacturing sector data limitations, it was not possible to determinate inward and outward transactions concerning each transmission mechanism for domestic and international perspectives. In order to measure this perspective via the liberalization effect, the interaction between financial and liquidity sector dependence ($CHAT_i^k$) and proxies for CAL sector measures were employed. This methodology of estimation is in line with Levchenk, Ranciere and Thoening's (2009) research where they use the interaction between financial and liquidity and average gross capital flows.

The results from tables 5.3 to 5.6, clearly confirm that sectors with larger financially and liquidity dependence are more affected by changes in CAL policy, as liberalization policy improved investment channels; which then caused an expansion of productivity.

As tables 5.3 to 5.6 investigated the effect of financial liberalization as interaction with sector financial and liquidity dependence on productivity, the effect is positive and robustly significant. These results are consistent across different TFP, especially with respect to sector liquidity dependents (see '**Green**' column in tables 5.3 to 5.6).

The final point of this empirical discussion presents the results from estimating the empirical model (1b), which explores the variation in proxies of CAL measures. The results from the estimating equation (1b), where the dependent variable total factor productivity is measured by nonparametric TFP index and by parametric TFP OLS are shown in Table 5.7 and in Table 6 respectively (see Appendix 5).

Each column in Table 5.7 and Table 7 of Appendix 5 represent a different category of proxy for CAL sector, which is a part of the independent variable of interest as an interaction between proxy of CAL sector measures $(CAL\ Sector_{it})$ and dependence industry characteristic $(CHAT_i)$. In order to clarify the analysis, colour coding was used in the tables below to represent each of the main capital transmission mechanisms: deposits and securities transactions ("blue"), loans, credits and debt transactions ("green") and profit transfers ("yellow").

As discussed above, the TFP index measure is more suitable for further analysis than the parametric TPF OLS measure since the TFP index is not under restrictions of fixed share of inputs over time. Thus, the usage of the TFP index as dependent variable is more appropriate to investigate if any of capital transmission channels have impact on changes in TFP. As the results of this, the estimations where the dependent variable is the TPF index, were processed by usage of financial and liquidity sectoral dependent. These estimation results seem to be consistent across various sectoral dependent measures. In addition, the results from tables 5.3 to 5.6 confirmed that the sector dependence liquidity needs variables also seem to provide consistent results of positive impact. Therefore, it seems logical to investigate this further using the various possible channels discussed in Section 5.2 and presented in Table 5.7. Furthermore, the estimation of this model by using the other liquidity and financial sectoral dependent are consistent with the results in Table 5.7.

Table 5.12: Difference in Difference results analyse, the relation between De Facto CAL measures, joint effect of sector liquidity dependent (on/off) and CAL transmission channels and TFP Index

	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	SD/GVA	BCL1/GVA	BCL2/GVA	BCL/GVA	TD/GVA	ICL/GVA	CL/GVA	VP1/GVA	VP2/GVA	VP3/GVA	UP1/GVA	UP2/GVA
Log of Investment / GVA (t-1)	-3.693	-4.431**	-3.336	-4.773**	-2.706	-2.584	-3.962*	-0.856	-3.468	-3.505	-3.174	-2.584
	(1.901)	(1.694)	(1.747)	(1.815)	(1.381)	(1.863)	(1.563)	(1.533)	(1.919)	(1.907)	(1.840)	(1.996)
Openness (t)	1.006	1.626*	1.108	1.045	0.511	2.526***	0.816	2.709***	1.055	1.063	2.269**	1.622*
	(0.587)	(0.653)	(0.640)	(0.652)	(0.520)	(0.735)	(0.574)	(0.795)	(0.580)	(0.580)	(0.712)	(0.685)
IMF(t)	0.422***	0.448***	0.298**	0.395***	0.262***	0.398***	0.309***	0.367***	0.405***	0.403***	0.392***	0.421***
	(0.100)	(0.092)	(0.099)	(0.094)	(0.078)	(0.097)	(0.084)	(0.081)	(0.096)	(0.096)	(0.097)	(0.098)
Chat Liquidity I (t)	0.270	-0.263	0.166	-0.249	0.483	-0.209	0.415	0.160	0.098	0.089	0.124	0.129
	(0.389)	(0.344)	(0.388)	(0.393)	(0.325)	(0.365)	(0.349)	(0.312)	(0.343)	(0.341)	(0.355)	(0.367)
CAL Sector (t)	7.372*	0.676	5.298*	2.097*	8.047***	4.124***	2.581***	0.092***	-1.305**	-1.314**	19.841***	-3.722
	(3.654)	(1.304)	(2.055)	(1.060)	(2.155)	(1.234)	(0.714)	(0.023)	(0.486)	(0.500)	(5.215)	(5.014)
Chat Liquidity * CAL Sector(t)	-0.056	1.970***	0.166	0.588*	0.104	-0.049	0.095	0.062	0.356	0.325	-14.221**	31.422*
	(0.357)	(0.546)	(0.358)	(0.262)	(0.097)	(0.969)	(0.073)	(0.048)	(0.472)	(0.480)	(5.469)	(14.652)
Constant	-5.998	-0.212	-4.096*	-2.272	-13.785***	-5.501**	-10.267**	-3.562*	1.062	1.066	-1.417	-0.351
	(3.153)	(1.074)	(1.908)	(1.641)	(4.133)	(1.937)	(3.302)	(1.509)	(0.787)	(0.783)	(1.033)	(0.911)
Yearly Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sector Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	264	264	264	264	264	264	264	264	264	264	264	264
R-sq	0.773	0.786	0.781	0.789	0.831	0.783	0.826	0.827	0.814	0.814	0.772	0.766
AIC	164.654	149.476	155.492	145.412	87.207	152.537	94.558	93.157	112.178	112.789	166.046	172.527
BIC	293.388	278.210	284.226	274.146	215.941	281.271	223.292	221.892	240.912	241.523	294.780	301.261

Notes: Robust standard errors in brackets; * p<0.05, ** p<0.01, *** p<0.001-reject the Null hypothesis. The sample is a panel for the period between 1996 and 2007. The dependent variable is the TFP Index based. IMF is on/off CAL measure on the country level, Log of Investment/GVA is the log of Investments on fixed assets per Gross Value Added in sector over time, Openness is log of the sum of export and import per Gross Value Added, Chat Liquidity I is on/off sector-level measure of liquidity needs based on Cash Conversions Cycle *Source:* Polish CSO's manufacturing sector data.

The empirical results in Table 5.12, suggests that financial liberalization does effect productivity through both the described capital transmission mechanisms such as, credit and loans transactions channels and unseen profit transfers. However, this impact is generally positive on productivity. The sectors which are more liquidity dependent, benefit in high productivity by an increase between 1.9% and 0.58% than in less dependent sectors thorough the changes in long-term liabilities from banks ($BCL1/GVA_{it}$) and total value of banking credits and loans (BCL/GVA_{it}), as a result Poland liberalized capital account transaction. This is confirmation of the possible reduction in cost of credits and financing debt as a result of financial liberalization, which is via investment channel affect productivity. This might be evidence of possible allocative efficient effects. This explanation is also confirmed by the results with respect to a ratio of expenditure on innovation know-how to Gross Value Added ($UP2/GVA_{it}$). The significant reduction in cost of capital, increase the actual investment in know-how

which leads to productivity increase. Also, this confirms that this measure might be imperfect measure of the unseen profits effects.

On the other hand, a negative coefficient of interaction between ratio of expenditure on innovations to Gross Value Added ($UP1/GVA_{it}$) and the sector liquidity dependence variable suggests that transfer of unseen profits happens which affects productivity or that is an actual measure of investment in innovations. This coefficient might pick up on the financial black hole effect. The reduction in the cost of capital allows sectors with high liquidity to finance unproductive investment projects, which resulted in lower productivity. Alternatively, this coefficient of interaction between sector characteristic and ratio of expenditure on innovations to Gross Value Added ($UP1/GVA_{it}$) could suggest the existence of weak banking discipline in providing credits or a lack of proper prudential and supervisory regulations.

Overall, these results suggest that CAL had a significant effect on the productivity of the Polish manufacturing sector. Exploring the variation in sectorial financial and liquidity characteristics allows us to establish the existence of a positive causal effect of this liberalization on manufacturing productivity. This runs counter to the standard intuition and in line with existing literature such as, Rajan and Zingales (1998), Raddatz (2006) and Levchennko, Ranciere and Thoening (2007), as financial liberalization is expected to channel funds to the most productive firms. The argument here follows, that the sector that is more financially dependent will be more affected by changes in the CAL policy because the liberalization of CAL policy should cause an increase of capital availability in the country and then through investment channels which will lead to an expansion of productivity. However, deeper analysis on the impact of each capital transmission mechanism through this liberalization suggests possible mixed results, as the results show a financial black hole and lack of proper banking discipline or prudential and supervisory regulations.

5.5. Conclusion

As theoretically and empirically argued by different streams of literature, CAL should affect productivity however, results are inconclusive regarding the sign of this impact. Along with claims that CAL might increase financial instability, financial black holes, and animal spirits which can decrease productivity, there are claims that CAL can give a 'positive' signal to the market by reducing the cost of capital, improving capital allocations, and improving financial development which can positively affect productivity.

In order to investigate this impact of CAL on productivity, with a panel of manufacturing industry–level data for Poland, as this country was under intensive liberalization reforms since the beginning of the 1990s. Two different measures of TFP (parametric-OLS and nonparametric approach-index) were applied as well as a variety of Difference in Differences estimates, which are standard for this type of analysis. However, the present research concludes that the TFP index is more adequate for this investigation as it is less restricted.

A key strength of this paper is the proposition of an alternative strategy to estimate the relationship between liberalization and productivity. The capital transmission mechanism allows us to define a proxy for CAL sector measures and in this way, to exploit through which channel the CAL process will be transferred into the sector-level productivity. The capital transmission mechanisms, so-called proxy of CAL sector measures, are divided up into three main channels: 1) deposits and securities transactions, 2) loans, credits and debt transactions and 3) profit transfers.

Apart from the application of this strategy, this research adopts the standard approach used by Rajan and Zingales (1998) and Raddatz (2006) to analyse the impact of CAL on productivity by defining financial dependence sectors and non-financial dependence sectors and sector productivity that responds to this liberalization process. This analysis also investigates the liquidity dependence characteristic of sectors. This empirically-based results show strong evidence that the CAL process has a positive impact on productivity in financial and liquidity dependence sectors. In other words, post liberalization of capital account transaction effect was stronger on productivity in

sector liquidity dependent with longer periods for transferring raw materials for final products into cash payments for these products by 8 percent than in the financial dependence sector measured by share of equity.

An alternative empirical strategy confirms the same impact on productivity via the relation between sector liquidity dependence and capital transmissions mechanism. There are clear evidences that this liberalization affects productivity through two out of the three channels which are, profits transfer, and channel credit and loans transactions. The impact through credit and loans transactions suggests possible existence of allocative efficient effects. However, the coefficient on the interaction between the long-term liabilities from banks and sector characteristics provides some evidence of negative impact of CAL process on productivity. This suggests that financial liberalization creates an environment with larger access to credits for unproductive projects of individual companies which can result in lower productivity, as it was described by Ranciere and Tornell (2011), as the effect of a financial black hole. Also, this coefficient can suggest weak banking discipline in providing credits or a lack of proper macroeconomic prudential which can be related to possible impact through Animal Spirit.

The profit transfer channel provides evidence that the CAL effect has mixed impact on productivity. In one hand, the increase of visible profits transfer such as Net Financial Results and Retained Earnings suggest that the liberalization process of capital flows has a positive impact on sectors with more liquidity dependence, which obtain higher productivity than less dependent sectors. In the other hand, the analysis of invisible profit transfers and sector liquidity dependence does not give a conclusive answer especially through the expenditure on innovations channel.

In summary, this research can observe that CAL is one of the factors that causes an increase of productivity. However, it does not happen equally throughout the different channels of capital transfer into the company in the manufacturing sector.

Chapter 6: Conclusion

The topic of capital account liberalization and economic growth is an important issue for today's emerging market economies in the current era of technological progress, multinational financial transaction and financial crisis. However, this is not a new issue, as there were similar situations in the early era of globalization, from 1870-1914 when capital flows were free of any restrictions (see Summer, 2000; Stiglitz and Charlton, 2004), Though in that period, money could not be transferred instantaneously with the press of a button from one part of the world to another.

This thesis has examined the impact of Capital Account Liberalization on productivity growth, analytical measures and changes in the capital control process, cross-country and on productivity changes using the case study of Poland. The primary focus of this thesis has been on the macro level: factors that differentiate capital control by country, including economic growth, financial instability and crisis, and macro-economic policy. The secondary focus has been on the micro level: factors that differentiate manufacturing sectors performances, including trade policy, investment flows, and productivity. This thesis also proposes and investigates transmission mechanism channels between the CAL process and productivity of sector-levels. Empirically this thesis mainly focuses on the case of Poland, for the period between 1995 and 2007.

The research is centered on the application of different techniques of panel data analysis to provide a statistical description of the trends and changes in productivity and capital control regulations. Including several econometrics techniques such as, the Linear Probability Model, Fixed Effect Panel and the Difference in Difference model. In doing so this thesis investigates some of the structural features of Polish manufacturing production, and the role of capital flows. This is important in terms of understanding some of the causes of productivity changes and how these changes happen over time and of the possible effects and types of policies.

Therefore, this concluding chapter discusses the results, for the limitation of the methodology and the policy conclusion for each chapter in turn.

Chapter 1 of the thesis provides a short description of the key reforms, with respect to Capital Account Liberalization in Poland; it also describes the main features of each chapter.

Chapter 2 describes existing measure of capital control and identifies their strengths and weakness. The CAL measures are mainly divided into two categories, namely de *jure* or *de facto* measures. As the chapter discusses, The CAL measures are quite imprecise, because they are based on imprecise capital flow classifications and government regulations. Moreover, a majority of the CAL measures are based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), which also leads to a lack of diversification between measures. The chapter argues, that the best measure should include de jure and de facto features of CAL measure characteristics, which suggests that the analysis should be brought to a micro-level. In this manner, these techniques were used to avoid capital controls and shift capital across borders, which are not detected by government agencies; consequently, they might be captured using these measures.[1] Moreover, Chapter 2 proposes three re-constructed measures to capture the CAL effect on the real economy.

Chapter 3 analyses, determinates the Capital Account Liberalization process with respect to the investigation on economic growth and financial instability on a cross-country level. The CAL process is measured based on a selection of CAL indicators from Chapter 2. The first part of the empirical analysis investigates using a Linear Probability Model. Thereafter, a Fixed Effect Panel model analysis and investigates the impact of different determinants on the intensity of CAL process. These results, suggest that there is little evidence of economic growth impact on this liberalization process, the main reasons being political stability and differences between interest rates. Chapter

[1] Income-corporate tax evasion or money laundering (see Mathieson and Rojas-Suarez, 1992; De Boyrie et al.,200;, Sohn,2002; Forbes, 2007)

3 also has some limitations with regards to the sample size of countries and the time period. However, the time period was chosen to be consistent with the sector-level analysis for Poland.

Chapter 4 examines the levels of productivity, production and capital in Poland over the period between 1995 and 2007. Different TFP calculation were used and independent variable sets were examined, the comparability of TFP estimates were derived from two main techniques such as, TFP index (non-parametric approach) and TFP OLS (parametric approach). This analysis shows, that there is an upward trend of productivity, which could have happened during the intensive process of privatization and capital account liberalization, and during certain stabilizations of macro-economic situations. There are some limitations to the results obtained in Chapter 4. Firstly, there is an issue with regards to the deflation factor, which should vary over different sectors. However, it was still possible to obtain consistency over the time indicator. The second methodological issue concerns the period of analysis; so the period chosen was to have consistent data according to the same classification (NACE Rev 1.1).

Chapter 5 examines the relation between CAL and productivity growth at the sectoral level. The literature review on productivity is determined by number of characteristics that is important to determine productivity growth. These include, the characteristics of the firm (investment policy, R&D, technology, human capital), characteristics of the country policy (privatization, EU integration, Trade openness) and industry characteristics (sector financial dependence, sector liquidity dependence). The chapter also examines productivity changes by two strategies; the first strategy focuses on analyzing the CAL impact on TFP through sector characteristics, both sets of results suggests that the CAL process has a mainly positive robust impact on the TFP. Moreover, the sectors which are more financially dependent, experience a significantly larger increase in TFP after the CAL process. The second empirical strategy focuses on the proposal, for a capital flow transmission mechanism, which allows for the construction of a proxy CAL measure; which confirms that there is a positive impact on

TFP through the CAL process, showing that this impact could explain the results of allocate efficiency.

To sum up, this thesis has examined the changes in Capital Control regulations with respect to Polish productivity through a period of significant political and economic changes. The analysis of Capital Account Liberalization changes over time and cross-country, has been examined and the structures of Capital control changes have been investigated. The methodology, although not without limitations, has used several practical techniques for distributional analysis using the best source of data available for such an analysis. The contribution of this thesis goes far beyond simply providing more "statistics" on productivity and the CAL process for the case of Poland.

Furthermore, this thesis also contributes to existing literature on capital account liberalization by overcoming certain empirical problems; firstly, it identifies and isolates the effects of CAL reform on sector level through capital flow transmission mechanisms, avoiding measurement problems in the explanatory variable. Second, with the help of a manufacturing sector database, it explores the forces that are driving output and productivity growth at the micro-level. Lastly, this thesis has also provided an additional method to capture the CAL process on a macro level. However, it acknowledges that further research is needed to consolidate some of the results on firm-level analysis and to fully test policy implications.

Appendix 2: Tables, Figures and notes for Chapter 2

Table 1: Summary table of CAL data sources

IMF on/off and intensity measures -Data Sources
IMF on/off index- IMF's AREAER Annual Report Arrangements and Exchange Restrictions and Bekeart, Campbell and Lundblad (2005)
The data covers the period between 1980 and 2006 for the category "Restrictions on payments for the capital transactions" in the IMF's AREAER (or since 1998 it has been called "*Capital Transaction"*). Data for the period between 1980 and 1998 was obtained from Bekeart, Campbell and Lundblad's (2005) analysis for 95 countries. Then a period between 1998 and 2006 was obtained from a hard copy of the IMF's AREAER. Basing on the hard copy report al indicators is computed. The IMF's AREAER provides information for 190 countries for a period from 1998-2006. The AREAER report provides a description of exchange rate arrangements, trade restrictions, restrictions on current and capital account transactions, which has been published since 1950. During the whole period this report has been modified. Important changes were made in 1996, after intensive criticism from academic critics stating that AREAER does not distinguish between the different types of flows that are being restricted (see Eichengreen, 2001, Chinn and Ito, 2007, 2008). However, it is important to mention that the coverage for the whole period was similar in scope but was less detailed before 1997 (see Kose, Prasad, Rogoff and Wei, 2006). For instance the core summary table which contains 6 different categories- such as (see AREAER 2005): 1. Status under IMF Articles of Agreement (Articles VII and XIV) 2. Exchange rate arrangements (includes exchange arrangements and regimes: pegged exchange rate, pegged exchange rates and flexibility limited for exchange rates, and independently floating rates) 3. Bilateral payment arrangements with members and non-members 4. Export proceeds (Surrender/repatriation requirements) 5. Payment Restrictions (Restriction on payments on current accounts and capital account transactions) 6. Cost-related Import Restrictions (Import surcharges, Advance Imports deposits). Since 1996 there have been 7 more important categories in the AREAER report which have considered the differences between non-residents and resident transactions. Furthermore, the publications have disaggregated capital account transactions into 13 subcategories (in 1996, there were 12 subcategories, and then in 1997, they added an additional category "Personal Capital Movements"). The publication also presented the following categories (see AERAER , 2007, Kose, Prasad, Rogoff and Wei, 2006): 1. **Exchange structure** (the official information about legal tender of the country, dual or multiple exchange rate) 2. **Exchange rate arrangements**: different exchange rate arrangements (exchange arrangement with no separate legal tender, exchange tax, exchange subsidy, existence of forward exchange market) and various exchange regimes (currency board arrangement, pegged, crawling peg, crawling band, independently floating exchange rate). 3. **Arrangements for Payments and Receipts**: Bilateral or regional arrangements for international payments and receipts, controls on trade of gold (coins, bullion) and banknotes. 4. **Resident or nonresident accounts**: includes regulations about the nature and operation of different types of accounts, an approval from the exchange control authority to open these accounts, regulations prohibiting or limiting the conversion/transfer of the balance of these accounts. 5. **Imports and import payments/exports and export proceeds**: -Restrictions on the nature and extent of exchange and trade restrictions on imports (existence of a foreign exchange plan, financing requirements for imports[1], document requirements for release of foreign exchange for imports (such as domiciliation requirements, pre-shipment inspections, letters of credits, import licenses as exchange licenses), imports licenses and other non-tariff measures (positive list (negative), prohibitions on import of certain (all) goods from all (certain) countries, import taxes, tariff systems, state import monopoly). -Restrictions on the use of export proceeds and regulations on exports (repatriation requirements, surrender requirements, financing requirements, documentation requirements (such as export licenses, export taxes). 6. **The procedures and regulations of invisible transactions and transfers**: -Payments for invisible transactions and current transfers (trade-related payments, investment-related payments, payments for travel (e.g. travel for business or tourism), personal payments (e.g. medical expenditures abroad, pensions, study expenses abroad, family maintenance), foreign workers' wages, credit and debit cards use abroad, subscription and membership fees, author's royalties, consulting and legal fees -Proceeds from invisible transactions and current transfers (repatriation requirements and restrictions on use of funds)

[1] Specifically important- financing regulations limiting the rights of residents to enter into private contracts in which financing options differ from those of the official regulations.

7. Capital Account Transactions (Capital Transactions).

The coverage of the regulations applies to receipts as well as to payments and to actions initiated by nonresidents and residents in the context of controls and Provisions involving capital account transactions. The whole category is divided into the following subcategories:

-**Control on capital market securities**- shares and other securities of a participating nature, and bonds and other securities (notes and debentures) with an original maturity of more than one year.

-**Money market instruments**- securities with an original maturity of one year or less- such as certificates of deposit and bills of exchange, treasury bills, other short-term government paper, banker's acceptance, commercial papers. Interbank deposits and repurchase agreements.

-**Collective investment securities**- share certificates and registry entries or other evidence of investor interest in an institution for collective investments, such as mutual funds and investment trusts.

-**Derivatives and other instruments**- include operations in other negotiable instruments and non-securitized claims which are not covered under the subsections above. In this subcategory, there are these following financial instruments: operations in rights, warrants, financial options, futures, secondary market operations in other financial claims, forward operations, swaps of bonds and other debt securities, credits and loans and other swaps (e.g. interest rate, debt/equity, foreign currency), operations in foreign exchanges without any other underlying transaction (spot or forward trading on the foreign exchange markets, forward cover operations).

-**Commercial credits**- covers operations directly linked to international trade transactions or with the rendering of international services

-**Financial credits**- include credits other than commercial credits granted by all residents, including banks, to nonresidents, or vice versa.

-**Guarantees, securities, and financial backup facilities-** include those provided by residents to nonresidents and vice versa. It also includes securities pledged for payment of a contracts (such as warrants, performance bonds, and letter of credit) and financial backup facilities that are credit facilities which are used as a guarantee for independent financial operations.

-**Direct investment (DI)-** refers to investments made abroad (domestically) by residents (nonresidents) which allow investors to participate in the management of the company (lasting economic relations). Therefore, there are outward DI and inward DI categories.

-**Liquidation of direct investment (LDI)** - refers to the transfer of principal, including the initial capital and capital gains of a direct investments defined above.

-**Real estate transactions**- refer to the acquisition of real estate not associated with direct investments, including (e.g. investments of a purely financial nature in real estate, the acquisition of real estate for personal use).

-**Personal capital movements**- transfers are initiated on behalf of private persons and intended to benefit other private persons. These transactions are considered as the return of the property to the owner, such as- interest payment (loans, settlements of debts in the country of origin by immigrants) and transfers are effected free of charge for the beneficiary (gifts, endowments, inheritances, legacies, emigrant's assets, transfer of gambling and prize earning)

- **Provisions specific**

i) ***Provision specific to commercial banks and other credit institutions***- describes regulations that are specific to these institutions, such as monetary, prudential controls, and foreign exchange controls. Indeed, some items such as borrowing abroad, lending to nonresidents, purchase of locally issued securities denominated in foreign exchange are considered in the above subcategories (DI and LDI etc.). However, controls on commercial banks and other credit institutions allow for a twofold verification and also investigate how the capital control regulations impact the entire financial system (especially the open foreign exchange position limits the category which describes the regulations for certain commercial bank balance sheet items (including capital) and on limits covering a commercial bank's positions in foreign currencies (including gold))

ii) ***Provision specific to institutional investors***- describes control regulations on composition of portfolio (limitations of foreign current assets (reserves, accounts) or liabilities (e.g. investments in equity capital of institutional investors or borrowing from nonresidents)) in institutions such as insurance companies, pension funds, investment funds (brokers, dealers, advisory firms) and other securities firms (e.g. collective investment funds). [2]

However, for seven countries, the data is not available throughout the period because of political transformations after 1990.The missing information Rep of Montenegro (2006), San Marion (1998-2004, 2006), São Tomé and Principe (1998-2004, 2006), Serbia and Montenegro (2002-2006), Republic of Serbia (2006), Timor Leste (2002-2006), Yugoslavia (2000-2001), Haiti (2003-2006). Political transformation impacts: Rep of Montenegro -Starting in 1991, the Socialist Federal Republic of Yugoslavia disintegrated in the war which followed the secession of most of the country's constituent entities. From 1992 to 2000, some countries, including the United States, referred to the Federal Republic of Yugoslavia as Serbia and Montenegro. Serbia and Montenegro was established in 1992 as a federation called the Federal Republic of Yugoslavia. In 2003, it was reconstituted as a political union called the State Union of Serbia and Montenegro. On the 21st of May 2006, there was an independent referendum in the state of Montenegro. Final official results indicated on the 31st of May that 55.5% of voters voted in favour of independence. The state union effectively came to an end after Montenegro's formal declaration of independence on the 3rd of June 2006, and Serbia's formal declaration of independence on the 5th of June in 1999, following the United Nations-sponsored act of self-determination, Indonesia relinquished control of the territory and East Timor became the first new sovereign state sovereign on the 20th of May 2002.

[2] The last two subcategories (which belong to "Provisions specific to the financial sector) do not necessarily signify that the aim of the measures is to control the flow of capital.

Chinn and Ito database

Chinn-Ito index (*KAOPEN*) database is based on the IMF's AREAER report and includes a series for the time period from 1970-2009 for a total of 182 countries. Data are available on http://web.pdx.edu/~ito/Chinn-Ito_website.htm

Interest Rate Differentials Indicator

Economic Freedom of the World: Annual Report (EDWAR)

The annual report has been published since 1975 by the Fraser Institute. The aim of the document is to build an indicator of economic freedom for all nations around the world. Country samples and methodology has developed and expanded over the time. A number of different sources are in the report such as The World Bank, the IMF, and MRI Banker's Guide to Foreign Currency etc. (EDWAR 2008). The report began with a sample of 115 countries that contained 14 components (EDW 1975-1995) - which were grouped into four main research areas: Money and Inflation, Government Operations and Regulations, Takings and Discriminatory Taxation, and Restraints on International Exchange. However, the number of components have changed during the years (for instance 14 components in 1975, 1980, and 1995, 15 components in 1990, 17 components in 1997, 21 components in 2001, 23 component in 2000) (see EDW 1975-1995, EDWAR (various issues). The earliest issue of the report included 141 countries in which 23 components were divided into five areas:

1. Size of Government: Expenditures, Taxes, and Enterprises
   - A General government consumption of spending as a percentage of total consumption
   - B Transfers and subsidies as a percentage of GDP
   - C Government enterprises and investment
   - D Top marginal tax rate
     - ✓ Top marginal income tax rate
     - ✓ Top marginal income and payroll tax rates
2. Legal Structure and Security of Property Rights
   - A Judicial independence
   - B Impartial courts
   - C Protection of property rights
   - D Military interference in rule of law and the political process
   - E Integrity of the legal system
   - F Legal enforcement of contracts
   - G Regulatory restrictions on the sale of real property
3. Access to Sound Money
   - A Money growth
   - B Standard deviation of inflation
   - C Inflation: Most recent year
   - D Freedom to own foreign currency bank accounts
1. Freedom to Trade Internationally
   - A Taxes on international trade
     - ✓ Revenues from trade taxes
     - ✓ Mean tariff rate
     - ✓ Standard deviation of tariff rates
   - B Regulatory trade barriers
     - ✓ Non-tariff trade barriers (GCR)
     - ✓ Compliance cost of importing & exporting (DB)
   - C Size of trade sector relative to expected
   - D Black-market exchange rates
   - E International capital market controls
     - ✓ Foreign ownership / investment restrictions
     - ✓ Capital controls
4. Regulation of Credit, Labor, and Business
   - A Credit market regulations
     - ✓ Ownership of banks
     - ✓ Foreign bank competition
     - ✓ Private sector credit
     - ✓ Interest rate controls/negative real interest rates
   - B Labor market regulations
     - ✓ Minimum wage
     - ✓ Hiring and firing regulations
     - ✓ Centralized collective bargaining
     - ✓ Mandated cost of hiring
     - ✓ Mandated cost of worker dismissal
     - ✓ Conscription
   - C Business regulations
     - ✓ Price controls
     - ✓ Administrative requirements
     - ✓ Bureaucracy costs
     - ✓ Starting a business
     - ✓ Extra payments / bribes
     - ✓ Licensing restrictions
     - ✓ Cost of tax compliance

Following Chanda (2001, 2005), OECD CLCM, and AREAER, there are mainly five indicators from EDW and EWAR that can be considered as CAL measures and should to be described in details (see EDW(2008):

1. 3D Freedom to own foreign currency bank accounts- the scale of the index included 10, 5 and 0 where 10 is when foreign currency bank accounts are permissible without restrictions both domestically and abroad, 0 is when these accounts are restricted and 5 is if foreign currency bank accounts are permissible domestically but not abroad (or vice versa). Index Sources: IMF AREAER, Currency Data and Intelligence, Inc., World Currency Yearbook.

2. 4D Black-market exchange rates- This component is based on the percentage difference between the official and the parallel (black) market exchange rate. The scale of the index is between 0-10 where 10 described the countries without a black-market exchange rate (those with a domestic currency that is fully convertible without restrictions). And 0 rating is given when the black-market premium is increased or is equal to 50% percentage. Index Sources: Monetary Research Institute, MRI Bankers' Guide to Foreign Currency, <http://www.mriguide.com>, World Bank WDI, Currency Data and Intelligence, Inc., World Currency Yearbook, IMF IFS.
3. 4Ei International capital market controls- Foreign ownership/investment restrictions. This index's scale is between 1-7, where 1 is the situation where foreign ownership in companies of the domestic country is limited to minority stakes and frequently prohibited in key sectors. On the other side, 7 represent the opposite situation where the policy makers encourage the FDI. Main Sources: World Economic Forum, Global Competitiveness Report, < http://www.weforum.org/en/initiatives/gcp/index.htm>.
4. 4Eii) International capital market controls- Capital controls. The index's scale is between 0-10. The index is a sum of the number for not imposing restrictions divided by the total number of restrictions and multiplied by 10. The total number of restriction is 13 according to IMF's AREAER Report.
5. 5Aii) Credit market regulations- Foreign bank competition. This index started being published from 2004, its construction is based on two components; the denial rate of foreign bank license applications and foreign bank assets as a share of total banking. The scale of the index is between 3-10 where 10 is all or most foreign bank applications an if foreign banks have a large share of the banking sector assets (80-100 percent), and then 3 is a situation where more than half of the application for licensees where rejected and the share of the foreign bank assets is less than 39 percent. Index Sources: James R. Barth, Gerard Caprio, Jr., and Ross Levine, Bank Regulation and Supervision, World Economic Forum, Global Competitiveness Report (2001).

Stock Market Liberalization (SML) continue approach indicators source

The last categories of the SML mixed approach was obtained from three publications, the first one was Henry (2000a) (Country fund, Policy Decree and IF index change- 12 countries). The second publication was Kim and Singal (2000) which included SML data for 19 countries by investigating (IFC index changes and Policy Decree). The third one was Patro and Walda's (2005) article, whose paper included SML index based on the date of liberalization provided by Bekaert and Harvey (2000), Kim and Singal (2000) and Henry (2000a). Moreover, Henry's (2000a) publication includes information about SML dates from other publications such as Bekaer and Harvey (1995), Kim and Singal (2000), Buckberg and Earliest (1995).

Stock Market Liberalization (SML) policy-experience approach indicators source

The SML continue approach was obtained from the following papers Mitton (2006) (First firm investable- 28 countries), Chari and Henry (2002b) (Degree open factor and Date of market liberalization - 11 countries) Chari and Henry (2002a) (Date of market liberalization as defined in Chari and Henry (2002b)- 5 countries)

International Capital Flow indicators

IMF's Balance of Payment Statistics Yearbook

This database provided the following capital indicators: Direct Investment Abroad (*di_u*), Portfolio investment abroad (*pi_u*), Other Direct Investment outflows (*otherdi_u*), Direct Investment inflows (*di_i*), Portfelio investment inflows (*pi_i*), and Other Direct Investment inflows (*otherdi_i*). The followed codes were utilized for the followed variables: Direct Investment Abroad (*di_u*) [B24A…9], Portfolio investment abroad (pi_u) [B27A…9], Other Direct Investment outflows (otherdi_u) [B26A…9], Direct Investment inflows (*di_i*) [B24B…9], Portfolio investment inflows (pi_i) [B27B…9, Other Direct Investment inflows (otherdi_i) [B26B…9]. All these indicators are required for calculating Kray and Swan's (1998) indicator for 114 countries for period between 1995 and 2008. As Kray and Swan's index is computed as ration of country GDP, the value of GDP per country was obtained from World Bank's Global Development Finance and World Development Indicators

External Wealth of National Database by Milessi-Ferretti (2001, 2003, 2006a)

This database provided the following capital indicators: Portfolio Equity Assets (*pe_a*), Portfolio Equity Liabilities (*pe_l*), FDI assets (*fdi_a*), FDI liabilities (*fdi_l*), Debt assets (*da_*), Debt liabilities (*dl_*), Financial derivatives assets (*fdi_a*), Financial derivatives liabilities (*fdi_l*), Total Reserves (*tr*), Total Assets (*ta*), Total Liabilities (*tl*) and net external position (*nep*). All these indicators are required for calculating Lane//Milesi-Ferretti's indexes for 136 countries for a period between 1970 and 2006. The missing values are from 52.67% to 75% of observations with respect to different categories of Lane/Milesi-Ferretti (2001, 2005, and 2006) indicators.

Table 2: New measure based on Chinn and Ito's index criteria

A new measure (NW), based on Glick, Guo and Hutchinson's and Chinn and Ito's index, is a binary dummy that if a country has six or more restrictions in eleven of the "*Capital Transaction"* categories then a country is considered to be closed ('0'), x is country, t is year. Otherwise this index is equal to '1' as an open country.[3] This index will be able to overcome this problem as the data available suggests that it is worth the code of 10 subcategories instead of 11 subcategories (exception for Republic of Serbia for the year 2006 which has information for the 11 subcategories of "*Capital Transactions*"). However this new measure faces a problem when a half of the subcategories indicate a closed country and half states that the country is open. However, with regards to this new indicator, there are two possible outcomes which lead to a incorrect conclusion that the country is a capital account liberalized:

Case A) A proportion of the value "0" and "1" is equal among the 11 categories because there are missing values in some of the categories.[4]

Case B) A proportion of value the "1" is higher than "0" among the 11 categories because there are missing values in some of the categories.[5]

Case C) The last situation of missing value problems, is a case where the proportion of value "1" is lower than "0" among these 11 categories. Therefore in that case, Glick, Guo and Hutchison's (2004) index is equal to zero. In both cases it is not possible to conclude the capital account position of the country because, these countries were considered as missing values for some period. In this situation there are 25 countries in a sample.[6] In order to overcome this problem, five criteria were implemented on the base of Chinn and Ito (2008) index (CI index) and Glick, Guo and Hutchison's (2004) index (GGH index).

If five of the subcategories of "*Capital Transactions*" category are equal to '1' and the other five are equal to '0', and "money market instrument" subcategory is missing a value compared to the five criteria. All six criterias were presented with the description:

Firstly, when CI index was negative and Glick, Guo and Hutchison's (2004) index (GGH index) is equal "0", then NW index is "0" at period t in x country. The opposite situation is that CI index was positive and GGH index is equal "1", then NW index is "1" at period t in x country.

$$CI_{t,x} < 0 \wedge GGH_{t,x} = 0 \Rightarrow NW_{t,x} = 0$$

$$CI_{t,x} > 0 \wedge GGH_{t,x} = 1 \Rightarrow NW_{t,x} = 1$$

Secondly, if CI index decreases value between years t and t-1 ($\Delta_1 CI_{t,x} < 0$)[7] and Glick, Guo and Hutchison's (2004) index is equal "0", then NW index is "0". If CI index takes on higher values between years t and t-1 ($\Delta_1 CI_{t,x} > 0$) and GGH index is equal "1", then NW index is "1".

$$\Delta_1 CI_{t,x} < 0 \wedge GGH_{t,x} = 0 \Rightarrow NW_{t,x} = 0$$

$$\Delta_1 CI_{t,x} > 0 \wedge GGH_{t,x} = 1 \Rightarrow NW_{t,x} = 1$$

Third and fourth conditions were constructed in the cases when CI index has constant value for some period or GGH index is not possible to be compute as the results of missing values (for instance, Slovak Republic in 2006).

Thirdly, if CI index has the same value between two periods t and t-1 ($CI_{t,x} = CI_{t-1,x}$) and for periods t-1,

[3] In other words more than half of the subcategories are restricted under observation; the exception is Republic of Serbia in 2006.

[4] Between 1-5 missing values in 11 subcategories for instance the case of Federated States of Micronesia (2006) and Nepal (1998) In the case of Federated States of Micronesia (2006) and Nepal (1998) the rest of six subcategories, the three subcategories countries was recognized as closed ("1") and other three subcategories were equal "0".

[5] Between 1-5 missing values in 11 subcategories as the case of Slovak Republic (2006) and Yugoslavia (2001)

[6] Argentina (1998-99,2000,2003,2006), Australia (1998),Belgium (2006), Bosnia and Herzegovina (1998), Brazil (2002, 2004), Bulgaria (2003-2005), Czech Republic (2005), Dominican Republic (1998), Eritrea (1998-2005), Honduras (1998), Hungary (2005-2006), Iceland (2000-2006), Israel (1999), Kuwait (1999-2006), Lebanon (1998), Luxemburg (2006), Macedonia (former Republic of Yugoslav) (2002-2003), Maldives (2002-2006), Nigeria (1998), Romania (2002), Sierra Leona (1998-2000), Slovak Republic (2001), Slovenia (1999-2003), Spain (2001), Venezuela Republic Bolivarian de (2001-2005).

[7] $\Delta_1 CI_{t,x} = CI_{t,x} - CI_{t-1,x}$.

$NW_{t-1,x}$ index has value "1", then this approach looks at the period t-2. If CI index has bigger value (or same) for period t-2 compare to t-1 (or t) and $NW_{t-2,x}$ has value "1", then $NW_{t,x}$ is equal "1". On contrary, if CI index has a same value between two periods t and t-1 ($CI_{t,x} = CI_{t-1,x}$) and $NW_{t-1,x}$ index is equal "0", that $CI_{t-2,x}$ has smaller value than CI_{t-1} and $NW_{t-2,x} = 0$, then $NW_{t,x} = 0$.

$$CI_t = CI_{t-1} \wedge NW_{t-1,x} = 1 \wedge \Delta_1 CI_{t-1} >= 0 \wedge NW_{t-2,x} = 1 \Rightarrow NW_{t,x} = 1$$

$$CI_t = CI_{t-1} \wedge NW_{t-1,x} = 0 \wedge \Delta_1 CI_{t-1} <= 0 \wedge NW_{t-2,x} = 0 \Rightarrow NW_{t,x} = 0$$

Fourthly, if CI index has a same value for period longer than three periods (t=3) ($CI_t = CI_{t-1} = CI_{t-2} \ldots$) then the distribution of CI index is required to analyse. This approach is similar to Eichengreen, Rose and Wyplosz's (1996) Market Pressure Index (MPI).[8] If $CI_{t,x} > 0$ and $CI_{t,x} > \mu_{CI} + \sigma_{CI}$ then $NW_{t,x} = 1$ where μ_{CI} is the mean of the CI across the country sample and cross time (1998-2008) and σ_{CI} is the standard deviation of CI index across the country sample and cross time (1998-2008). If $CI_{t,x} < 0$ and $CI_{t,x} < \mu_{CI} - \sigma_{CI}$ then $NW_{t,x} = 0$ where μ_{CI} is the mean of the CI across the country sample and cross time (1998-2008) and σ_{CI} is the standard deviation of CI index across the country sample and cross time (1998-2008).

Fifthly, if CI index did not exist, then $GGH_{t,x} = NW_{t,x}$.

Sixtly, a criteria for treating missing values is analogous to Glick, Guo and Hutchison's (2004) index ($GGH_{t,x}$) and was adopted in the following cases: Federated States of Micronesia (2006), Nepal (1998),[9] Slovak Republic (2006) and Yugoslavia (2001).

A list of country presents the adaptation of above criterias:

Argentina (1998-2000, 2003, 2006)	1st critiria was used: For years 1998-2000, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$. For year 2003 CI index was negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$. For year 2006 CI index was negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$.
Australia (1998)	1st critiria was used: For years 1998-2000, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 0$.
Belgium (2006)	2nd critiria was used : For year 2006, $\Delta_1 CI_{t,x} < 0$ and $GGH_{x,t} = 0$ then $NW_{t,x} = 0$.
Bosnia and Herzegovina (1998)	5th critiria was used : For year 1998, $GGH_{t,x} = NW_{t,x} = 0$
Brazil (2002-2004)	1st critiria was used: For years 2002-2004, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$.
Bulgaria (2003-2005)	1st critiria was used: For years 2003-2005, CI indexes were negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$.
Czech Republic (2005)	1st critiria was used: For years 2005, CI index was positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$.
Dominican Republic (1998)	1st critiria was used:: For year 1998, CI index was negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$.

[8] The CI index did not have a normal distributed. For period 1998-2006 a maximum value of CI index is 2.539847, a minimum value is -1.797522 and a standard deviation is 1.518261.

[9] In the case of Federated States of Micronesia (2006) and Nepal (1998) the rest of six subcategories, the three subcategories country was recognized as closed "0" and other three were equal "1".

Eritrea (1998-2005)	1st critiria was used:: For years 1998-2005, CI indexes were negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$.
Honduras (1998)	1st critiria was used: For year 1998, CI index was negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$.
Hungary (2005-2006)	2nd criteria was used: For year 2006, $\Delta_1 CI_{t,x} < 0$ and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$. 3rd critiria was used: For year 2005, If $CI_{t,x} = CI_{t-1,x} \wedge NW_{t-1,x} = 1 \wedge \Delta_1 CI_{t-1,x} >= 0 \wedge NW_{t-2,x} = 1$ $\Rightarrow NW_{t,x} = 1$
Iceland (2000-2006)	1st critiria was used: For years 2000-2006, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$.
Israel (1999)	1st critiria was used: For year 1999, CI index was positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$
Kuwait (1999-2006)	1st critiria was used: For years 1998-2006, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$.
Lebanon (1998)	1st critiria was used: For year 1998, CI index was positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$
Luxemburg (2006)	5th critiria was used: For year 2006, $GGH_{t,x} = NW_{t,x} = 0$
Macedonia	1st critiria was used: For years 2002-2003, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$.
Maldives (2002-2006)	4th criteria was used for period 1998-2006: If $CI_{t,x} > 0$ and $CI_{t,x} > \mu_{CI} + \sigma_{CI}$ then $NW_{t,x} = 1$
Nigeria (1998)	2nd criteria was used: For year 1998, $\Delta_1 CI_{t,x} > 0$ and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$
Romania (2002)	1st critiria was used: For year 2002, CI indexes were positive and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$
Sierra Leona (1998-2000)	1st critiria was used: For years 1998-2000, CI index was negative and $GGH_{t,x} = 0$ then $NW_{t,x} = 0$.
Slovak Republic (2001)	3rd critiria was used: For year 2001: If $CI_{t,x} = CI_{t-1,x} \wedge NW_{t-1,x} = 0 \wedge \Delta_1 CI_{t,x} <= 0 \wedge NW_{t-2,x} = 0$ $\Rightarrow NW_{t,x} = 0$
Slovenia (1999-2003)	2nd criteria was used: For years 1999 , 2000 and 2003, $\Delta_1 CI_{t,x} > 0$ and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$ 3rd critiria was used: For years 2001 and 2002 If $CI_{t-1,x} = CI_{t,x} \wedge NW_{t-1,x} = 1 \wedge \Delta_1 CI_{t-1,x} >= 0 \wedge NW_{t-2,x} = 1$ $\Rightarrow NW_{t,x} = 1$

Spain (2001)	4th critiria was used: For 2001: If $CI_{t,x} > 0$ and $CI_{t,x} > \mu_{CI} + \sigma_{CI}$ then $NW_{t,x} = 1$
Venezuela Republic Bolivarian de (2001-2005)	3rd critiria was used: For years 2003-2005: If $CI_{t,x} = CI_{t-1,x} \wedge NW_{t-1,x} = 0 \wedge \Delta_1 CI_{t,x} <= 0 \wedge NW_{t-1,x} = 0$ $\Rightarrow NW_{t,x} = 0$ 2nd criteria was used: For year 2001, $\Delta_1 CI_{t,x} > 0$ and $GGH_{t,x} = 1$ then $NW_{t,x} = 1$

Table 3: The SML index, SML policy continuous approach and SML continuous approach and SML policy approach

Country name	SML index	SML mixed	SML continue approach	SML policy approach		SML policy approach	Reasons
				First ADR	First Country Fund		
Russia	1997		1997	1995		1995	First ADR regulation was established in 1995, nevertheless, as Mitton's (2006) SML continuous approach index shows that the nonresident investors started participating in Russian Stock Market in 1997. As SML continuous approach included the changes in the actual values of stock market performance which was purchased by nonresident investors.
Argentina	1989	1989	…	1991	1991	1989	In November 1989, Argentina implemented the changes in the policy decree of foreign participation in stock market. The policy decree allows for the free repatriation of capital and remittance of dividedness and capital gains for foreign investors. Also SML mixed indexes from different sources pointed out in 1989 as date of stock market liberalization. However, according to different sources such as Patro and Waldo (2005), Kim and Singal (2000 a,b), Henry (2001), SML continuous approach indexes cannot point out single dates.
Bangladesh	1991					1991	In June 1991, the policy decree was changed which allowed for a purchases of Bangladesh shares and securities by nonresidents, including nonresident Bangladeshis, subject to meeting procedural requirements.
Brazil	1991	1991	…	…	1992	1991	In 1991, foreign investment law changed. Resolution 1832 Annex IV stipulates that foreign institutions can now own up to 49% of voting stock and 100% of nonvoting stock. Economy ministers approved rules allowing direct foreign investments and 15% tax on distributed investments. However, according to different sources such as Patro and Waldo(2005), Kim and Singal(200 a,b), Henry (2001,2003), Bekeart, Campbell and Lundblad(2005), Mitton (2006), SML continue approach and SML policy approach- First ADR indexes cannot point out the single dates.
Botswana	1990					1990	In February 1998, the Bank of Botswana liberalized foreign participation in the stock market exchange. A non-resident can purchase up to 10% (from 5%) of the public float of a listed company without the permission of the Bank of Botswana, and the aggregate permitted share ownership in a given listed company for all non-resident portfolio investors has been increased from 49% to 55 % of the company's public float. Non-residents are permitted to invest unlimited amounts in pula-denominated bonds. Nonresidents are allowed to repatriate proceeds of up to US$26 million on disinvestment. If the amount to be repatriated exceeds US$100 million, it may be required to be repatriated in tranches over a period not exceeding three years.
Chile	1989	…	1989	1992	1989	…	In January 1992, a liberalization of foreign investments, reducing the minimum holding period and tax on investment income. However, legation of establishing First Country Fund was in 1989 and also it is visible changes through analysing SML policy continuous approaches (Chari and Henry, 2002b; Kim and Singal, 2000) that there is significant changes in the index in 1998.
China	1992		1992	1994	1992		A legation of establishing Fist Country Fund was done in 1992 and also it is visible change through analysing SML policy continuous approaches (Mitton, 2006).
Colombia	1991	1991	1991	…	1992	1991	In January 1991 Foreigners have the same rights as domestic investors and also it is visible changes through analysing SML policy continuous approaches (Chari and Henry,2002b; Kim and Singal, 2000) that there is significant changes in the index in 1991
Czech Republic	1994		1994	1995	1994	…	In 1994 First country Fund was established and also it is visible changes through analysing SML policy continuous approaches (Chari and Henry, 2002b; Kim and Singal, 2000) that there is significant changes in the index in 1994. In addition by analysis the SML date that it was the most frequent happened among all different categories of SML index.
Cote d'Ivoire	1995					1995	National Assembly approved an Ivoirian Investment Code For all practical purposes, there are no significant limits on foreign investments (or difference in the treatment of foreign and national investors)
Ecuador	1994			1994		1994	IFC frontier market as of 1994
Egypt	1996			1996		1992	In 1996 First ADR was established even if the legislation changes was done in 1992. Capital Market law 95 grants foreign investors full access to capital markets. No restrictions are placed on foreign investment in the stock exchange
Spain	1988			1988		1985	In 1988 First ADR was established even if the legislation changes was done in 1985. By joining European Economic Community, which attracts an influx of foreign capital

Ghana	1995			1995		1993	In 1995 First ADR was established even if the legislation changes was done in 1993. In June 1993, non-residents were allowed to deal in securities listed on the Ghana Stock Exchange, subject to a 10% limit for an individual and 14% limit for trial holdings by non-residents in any one of the listed securities.
Greece	1988	…	1988	…	…	1987	In January 1997 Foreigners have the same rights as domestic investors and also it is visible changes through analysing SML policy continuous approaches (Chari and Henry,2002b; Kim and Singal, 2000) that there is significant changes in the index in 1998
Hungary	1996		1992	1996		1996	In 1996, Hungarian legal changes to liberalized stock exchange stock for non-residents and also First ADR was established.
Indonesia	1989	1989	1990	…	1989	1989	In September 1989 Minister of finance allows foreigners to purchase up to 49% of all companies listing shares on the domestic stock exchange excluding financial firms and also it is visible changes through analysing SML policy continuous approaches (Chari and Henry,2002b; Kim and Singal, 2000) that there is significant changes in the index in 1998
India	1992	1992	1992	…	1986	1992	In September 1992 the government announces that portfolio investors will be able to invest directly in listed Indian securities
Iceland	1991					1991	First shares trade on the Iceland Stock Exchange
Israel	1992		1997	1987	1992	1993	In November 1993, nonresidents were allowed to deposit into nonresident accounts on all incomes received from Israeli securities and real estate even if these were purchased from sources other than nonresident accounts. However Frist ADR was done in 1987, and then First Country Fund was established in 1992.
Jamaica	1993			1993		1991	In September 1991, all inward and outward capital transfers were permitted, except that financial institutions must match their Jamaican dollar liabilities to their clients with Jamaican dollar assets. In 1993, the introduction of ADR is the most reliable proxy because it includes both aspects of real changes and legal changes.
Jordan	1995	…	…			1995	In December 1995, Foreign investment by laws passed- allowing foreign investors to purchase shares without government approval.
Japan	1983					1983	In September 1983 Finance Ministry announces easing of restrictions on investments on stock by foreigners.
Kenya	1995					1995	In 1995, restrictions on investments by Foreigners in shares and government securities were removed The Capital Market Authority Act was amended to allow foreign equity participation of up to 40% of the listed companies.
Korea	1992	1992	…	1990	1984	1992	In January 1992, partial opening of the stock market to foreigners- Foreigners can now own up to 10% of domestically listed firms –565 foreign investors registered with the Securities Supervisory Board and then also SML mixed index showed changes in the middle of 1992.
Sri Lanka	1992		1992	1994		1991	In 1991, companies incorporated abroad were permitted to invest in securities traded at the Colombo Stock Exchange, subject to the same terms and conditions as those applicable to such investments that were approved by national funds, approved regional funds however SML mixed index showed changes in the middle of 1992
Morocco	1996			1996		1988	In June 1988, the repatriation of capital and income from investments into Morocco was granted. However the introduction of ADR in 1996 is the most reliable proxy because it includes both aspects of real changes and legal changes
Mexico	1989	1989	…	…	1981	1989	Tin 1989, restriction on foreign capital participation in new direct foreign investment were liberalized substantially.
Malta	1998			1998		1990	Malta Stock Exchange was established by an act of Parliament in 1990 however Frist ADR was established in 1998 which is the most reliable proxy because it includes both aspects of real changes and legal changes.
Mauritius						1994	In 1994, the stock market was opened to foreign investors following the lifting of exchange controls, Foreign investors do not approve to trade shares, unless investment is for the purpose of legal or management control of a Mauritian company or for hold
Malaysia	1988	1988	…	…	1987	1987	In October 1988, budget calls for liberalization of foreign ownership policies to attract more foreign investors. However, during Asian crisis, country decided to re-impose the Stock market regulations for short while. But introduction of ADR into the market was is 1987 but the actual changes in SML mixed index changed in 1998.
Nigeria	1995	1995		1998		1995	In 1995, Nigerian market was open to foreign portfolio investment
New Zealand	1983			1983		…	Major reforms of SML were initiated in 1986 and 1983. The introduction of ADR was in 1983 is the most reliable proxy because it includes both aspects of real changes and legal changes
Oman	1999					1999	A stand-alone global index for Oman was added to the Standard & Poor's Emerging Market Indices, which has a base date of December 31, 1998 S&P tracks both global and instable indices for Oman

Pakistan	1991	1991	1991	1994	1991	1991	In November 1991, no restriction on foreigners or nonresident Pakistanis purchasing shares of a listed company or subscribing to public offerings of shares subject to some approvals.
Peru	1992		1992	1994		1992	In December 1992, a Decree on the Private Sector Investment Guarantee Regime was enacted, under which the rights and guarantees that are according to domestic investors would be extended to foreign investors. But introduction of ADR into the maker was is 1994 but the actual changes in SML mixed index changed in 1992.
Philippines	1986	1986	1988	…	1987	1991	In June 1991, Foreign Investment Act is signed into law, The Act removes, an overall period of three years, all restrictions on foreign investments. However, introduction of First Country Fund was in 1987 and also the actual changes in SML mixed index changed in 1986
Poland	1995		1992	1997	1995	…	In 1996, the Polish government gave permission for the purchasing of company shares and participations above 10% of the vote in a company, the company's base allocated in OECD countries or countries with which Poland has an agreement of mutual investment protection. There were some limits to particular sectors of the economy such as seaport & airport, real estate brokerage, purchase and sale of transactions. However, an introduction of First Country Fund was in 1987.
Portugal	1986	1986	1988	…	1987	1986	In July 1986, all restrictions on foreign investments are removed except for the arms sector investments and also the actual changes in SML mixed index changed in 1986.
Saudi Arabia	1997				1997	1996	In October 1996, the Ministry of finance announced the ground breaking decision to allow non-Saudi investors to own shares in the local market though mutual funds and in 1997 First Country fund was established.
Slovakia	1997		1997				Actual changes in SML mixed index changed in 1997.
Taiwan	1991	1991	1991	1992	1986	1991	In January 1991, implementation date of phase two of liberalization plan. Eligible foreign institutional investors may now invest directly in Taiwan securities subject to approval.
Thailand	1988	1988	1988	…	1985	1987	In September 1987, Inauguration of the Alien Board on Thailand's Stock Exchange The Alien Board allows foreigners to trade stocks of those companies that have reached their foreign investment limits. Actually changes in SML mixed index and SML continue approach changed in 1988.
Trinidad and Tobago	1994				1994	1987	In September 1987, Inauguration of the Alien Board on Thailand's Stock Exchange The Alien Board allows foreigners to trade stocks of those companies that have reached their foreign investment limits. However, an introduction of First Country Fund was in 1994.
Tunisia	1998			1998		1995	In June 1995, Inward portfolio investment was partially liberalized. However, an introduction of First Country Fund was in 1987.
Turkey	1989	1989	1989	…	1989	1989	In August 1989, foreign investors were permitted to trade in listed securities with no restrictions at all and pay no withholding or capital gains tax provided there registered with the capital Market Board and the Treasury.
Venezuela	1990	1990	1990	1991		1990	In January 1990, Decree 727 opened foreign direct investment for all stocks except bank stock. Actually changes in SML mixed index and SML continue approach changed in 1990.
South Africa	1994		1992	…	1994	1996	In 1996, restrictions on foreign membership in the Johannesburg Stock Exchange lifted however, First Country fund was established in 1994.
Zimbabwe	1993	1993	1993			1993	In June 1993, Zimbabwe Stock Exchange was opne to fireung portfolio investment subject to ceratin conditions.

Notes: …-impossible to point out the liberalization date. *Sources*: Henry (2000a, b); Henry (2003); Kim and Singal (2000); Patro and Walda (2005); Bekaert and Harvey (2000); Henry and Sasson (2008); Mitton (2006); Bekeart et al. (2005) and Chari and Henry (2002a,b).

Table 4: The summary statistics for CAL measures for period 1980 and 2006

Variables	Obs	Mean	St. Dev.	Min	Max
IMF index	2587	0.3026672	0.4595012	0	1
Glick, Gou and Hutchison's (2004) index	849	0.4923439	0.500	0	1
A new measure based on Chinn and Ito's (2002) index	848	0.427	0.495	0	1
Chinn and Ito's index	2411	0.196	1.563	0	1
Capital Transaction Index	855	5.398	3.523	0	13
SML Index	1161	0.546	0.498	0	1
IFIGDP	2050	0.000000286	0.000000438	0	0.00000656
GEQGDP	1523	0.00000126	0.0000085	0	0.0001788
Chanda's index	2326	6.36	3.137949	0	10
Kray (1998), and Swan (1998)'s index	695	0.000000000000104	0.000000000000103	-0.000000000000529	0.00000000000143

Note: Obs-observations *Sources:* "External Wealth of Nations" Dataset, Economic Freedom of the World: Annual Report (EDWAR), IMF's AREAER (various years), Chinn and Ito's database, IMF's BOP database, Henry (2000a, b), Henry (2003), Kim and Singal (2000), Patro and Walda (2005), Bekaert and Harvey (2000), Henry and Sasson (2008), Mitton (2006), Bekeart, Campbell and Lundblad (2005) and Chari and Henry (2002a,b)

Appendix 4: Tables, Figures and Notes for Chapter 4

Appendix 4.3

Table 1: NACE Rev 1.1 Classification

NACE Rev 1.1. classification		Sector name
D		**Manufacturing**
DA	15	Manufacture of food products and beverages
DA	16	Manufacture of tobacco products
DB	17	Manufacture of textiles
DB	18	Manufacture of wearing apparel and furriery
DC	19	Processing of leather and manufacture of leather products
DD	20	Manufacture of wood and wood, straw and wicker products
DE	21	Manufacture of pulp and paper
DE	22	Publishing, printing and reproduction of recorded media
DF	23	Manufacture of coke, refined petroleum products
DG	24	Manufacture of chemicals and chemical products
DH	25	Manufacture of rubber and plastic products
DI	26	Manufacture of other non-metallic mineral products
DJ	27	Manufacture of basic metals
DJ	28	Manufacture of metal products
DK	29	Manufacture of machinery and equipment n.e.c
DL	30	Manufacture of office machinery and computers
DL	31	Manufacture of electrical machinery and apparatus
DL	32	Manufacture of radio, television and communication equipment and apparatus
DL	33	Manufacture of medical, precision and optical instrument, watches and clocks
DM	34	Manufacture of motor vehicles, trailer and semi-trailers
DM	35	Manufacture of other transport equipment
DN	36	Manufacture of furniture, manufacturing n.e.c

Source: Nomenclature des Activités de Communauté Européenne –NACE rev. 1.1

Appendix 4.4

Table 1: Summary statistics of key variables for TFP estimations.

Total Manufacturing					
Variable	Obs	Mean	Std. Dev.	Min	Max
Gross value added (GVA)	13	1.65E+11	5.00E+10	8.45E+10	2.52E+11
Gross value of fixed assets (GVFA)	13	4.82E+11	1.13E+11	2.39E+11	6.60E+11
Average paid employment(APE)	13	2.99E+09	3.36E+08	2.64E+09	3.46E+09
Mining and quarrying					
Variable	Obs	Mean	Std. Dev.	Min	Max
Gross value added (GVA)	13	1.67E+10	3.94E+09	1.10E+10	2.28E+10
Gross value of fixed assets (GVFA)	13	4.01E+10	5.63E+09	2.37E+10	4.82E+10
Average paid employment(APE)	13	2.51E+08	7.06E+07	1.80E+08	3.74E+08
Manufacturing					
Variable	Obs	Mean	Std. Dev.	Min	Max
Gross value added (GVA)	13	1.25E+11	3.83E+10	6.28E+10	1.95E+11
Gross value of fixed assets (GVFA)	13	2.53E+11	6.94E+10	1.21E+11	3.67E+11
Average paid employment(APE)	13	2.49E+09	2.48E+08	2.21E+09	2.82E+09
Electricity, gas, stem and hot water supply					
Variable	Obs	Mean	Std. Dev.	Min	Max
Gross value added (GVA)	13	2.32E+10	8.28E+09	1.07E+10	3.45E+10
Gross value of fixed assets (GVFA)	13	1.89E+11	4.09E+10	9.33E+10	2.45E+11
Average paid employment(APE)	13	2.45E+08	2.39E+07	2.13E+08	2.78E+08

Source: Author's calculations on estimating the sector data from Statistical Yearbook of Industry from Polish Central Statistical Office (CSO) (various years)

Table 2: Summary statistics of key variables for TFP estimations (22 manufacturing sectors).

Variable		Mean	Std. Dev.	Min	Max	Observations
Gross value added (GVA)	overall	5.43E+09	4.95E+09	1.95E+08	3.27E+10	N = 299
	between		4.47E+09	4.54E+08	2.09E+10	n = 23
	within		2.31E+09	-4.71E+09	1.72E+10	T = 13
Gross value of fixed assets (GVFA)	overall	1.10E+10	1.10E+10	1.46E+08	6.51E+10	N = 299
	between		1.02E+10	3.76E+08	4.28E+10	n = 23
	within		4.65E+09	-1.06E+10	3.33E+10	T = 13
Average paid employment(APE)	overall	1.08E+08	9.85E+07	4100000	5.11E+08	N = 299
	between		9.82E+07	4907692	4.55E+08	n = 23
	within		2.09E+07	4.63E+07	1.86E+08	T = 13
TFP Index	overall	1.769467	0.591743	-0.07553	4.223705	N = 299
	between		0.481409	0.320672	2.507235	n = 23
	within		0.357404	0.673566	3.835756	T = 13
TFP(OLS)	overall	3.101941	0.369169	2.113672	4.421537	N = 299
	between		0.289339	2.679415	3.895798	n = 23
	within		0.236516	2.446574	4.02757	T = 13

Source: Author's calculations on estimating the sector data from Statistical Yearbook of Industry from Polish Central Statistical Office (CSO) (various years)

Appendix 5: Tables, Figures and Notes for Chapter 5

Table 1: NACE Rev 1.1 Classification

NACE Rev 1.1. classification		Sector name
D		**Manufacturing**
DA	15	Manufacture of food products and beverages
DA	16	Manufacture of tobacco products
DB	17	Manufacture of textiles
DB	18	Manufacture of wearing apparel and furriery
DC	19	Processing of leather and manufacture of leather products
DD	20	Manufacture of wood and wood, straw and wicker products
DE	21	Manufacture of pulp and paper
DE	22	Publishing, printing and reproduction of recorded media
DF	23	Manufacture of coke, refined petroleum products
DG	24	Manufacture of chemicals and chemical products
DH	25	Manufacture of rubber and plastic products
DI	26	Manufacture of other non-metallic mineral products
DJ	27	Manufacture of basic metals
DJ	28	Manufacture of metal products
DK	29	Manufacture of machinery and equipment n.e.c
DL	30	Manufacture of office machinery and computers
DL	31	Manufacture of electrical machinery and apparatus
DL	32	Manufacture of radio, television and communication equipment and apparatus
DL	33	Manufacture of medical, precision and optical instrument, watches and clocks
DM	34	Manufacture of motor vehicles, trailer and semi-trailers
DM	35	Manufacture of other transport equipment
DN	36	Manufacture of furniture, manufacturing n.e.c

Table 2: Description of variables for Benchmark equation

Variables	Definition
Dependent variables	
$TFP\ OLS_{it}$	Parametric approach OLS estimations. Productivity was computed on the basis of the following inputs. Inputs of physical capital (K) might be defined by a gross value of fixed assets *(GVFA)* in a thousand zlotych and labour (L) is measured as average sale of full-time paid employees (*APE).* Source: Polish CSO's data
$TFP\ INDEX_{it}$	Non-parametric approach-Hicks-Moorsteen Index. Productivity was computed on the basis of the following inputs. Inputs of physical capital (K) might be defined by a gross value of fixed assets *(GVFA)* in thousand zlotych and labour (L) is measured as average sale of full-time paid employees (*APE).* Source: Polish CSO's data
Independent variable in benchmark equation	
$INVESTMENT_{i,t}$	A ratio of investment outlays on fixed assets to gross output. This fixed asset includes the value of buildings and places as well as civil engineering works. Source: Polish CSO's data
$OPENNESS_{i,t}$	A ratio of openness to a gross output where openness is a sum between exports and imports with respect to the total output for the whole economy. Trade data was transferred from 4 digits ISIC Rev 2 into 2 digits ISIC Rev 3.1 and, then, into 2 digits NACE Rev.1.1. The trade data from UN Comtrade were expressed in thousand dollars. In order to transfer them into polish zloty, the exchange official rate from IMF IFS were implemented (AG.ZF official rate, end of period (US dollar per zloty)[1].
Financial dependence/Liquidity dependence ($CHAT_i^k$)	
$CHAT_i^{Finance}$	There are two versions of this measures: 1) A first variation of these variables is on/off sector-level where "1" indicates sector financial dependence sectors and otherwise "0" is non-financial dependence sectors. This variable was computed based on the quartiles (Q2) analysis as the ratio of share equity to Gross Value Added. If the value of this ratio at level was below second quartile (Q2), then it indicates is to be '1', otherwise is it "0". 2) A second variation is the value of the ratio of share equity to Gross Value Added at the level of year 1995. Source: Polish CSO's data
$CHAT_i^{Liquidity\ I}$	There are two versions of this measures: 1) A first variation of these variables is on/off sector-level where "1" indicates sector liquidity dependence sectors and otherwise "0" is non-liquidity dependence sectors. This variable was computed based on the quartiles (Q2) analysis of the cash conversion cycle. If the value of this ratio at level was below Q2, then it indicates is to be '1', otherwise is it "0". 2) A second variation is the value of the cash conversion cycle at the level of year 1995. Source: Polish CSO's data
$CHAT_i^{Liquidity\ II}$	There are two versions of this measures: 1) A first variation of these variables is on/off sector-level where "1" indicates sector liquidity dependence sectors and otherwise "0" is non-liquidity dependence sectors. This variable was computed based on the quartiles (Q2) analysis of a ratio of inventories to a share of sales. If the value of this ratio at level was below Q2, then it indicates is to be '1', otherwise is it "0". 2) A second variation is the value of a ratio of inventories to a share of sales at the level of year 1995. Source: Polish CSO's data

[1] According to IMF IFS database, there are eight types of official exchange rate such as AA.ZF Official rate, end of period (units: National Currency per SDR), AB.ZF Official rate, (units: National Currency per SDR), AC.ZF Official rate, (units: SDR per National Currency), AD.ZF Official rate, (units: SDR per National Currency), AE.ZF Official rate, end of period (units: SDR per National Currency), AF.ZF Official rate (units: National Currency per US Dollar), AG.ZF end of period Official rate (Units: US Dollars per National Currency), AH.ZF Official rate (Unites: US Dollars per National Currency). It seems that all of them are having similar trends over time. Because, there is no need to transfer the value in to SDR unities, because trade data are expressed in US dollars. The choice is between annual average exchange rate AH.ZF Official rate (Unites: US Dollars per National Currency) or at the end period end of period AG.ZF end of period Official rate (Unites: US Dollars per National Currency).

Table 3: Description of variables for augmenting equations

CAL country-level measure	
imf_t	On-off measures have value between 0 and 1. An indicator takes the value of 0 before the liberalization episode, and 1 after. The indicator is based on the IMF's AREAER reports.
Proxy of CAL sector measures	
SD/GVA	logarithm of ratio between securities and deposit to GVA Source: Polish CSO's data
BCL1/GVA	logarithm of ratio between long-term banking credits loans to GVA Source: Polish CSO's data
BCL2/GVA	logarithm of ratio between short-term banking credits loans to GVA Source: Polish CSO's data
BCL/GVA	logarithm of ratio between banking credits loans to GVA where BCL=BCL1 +BCL2 Source: Polish CSO's data
TD/GVA	logarithm of ratio between short-term receivables to GVA Source: Polish CSO's data
ICL/GVA	logarithm of ratio between internal company credits to GVA Source: Polish CSO's data
CL/GVA	logarithm of ratio between credits & loan to GVA where CL1=BLC+TD1+ICL, Source: Polish CSO's data
VP1/GVA	logarithm of ratio between net financial results to GVA Source: Polish CSO's data
VP2/GVA	logarithm of ratio between financial revenues on economic activity to GVA Source: Polish CSO's data
VP3/GVA	logarithm of ratio between retained earnings to GVA Source: Polish CSO's data
UP1/GVA	logarithm of ratio between expenditure on innovation (marketing) to GVA Source: Polish CSO's data
UP2/GVA	logarithm of ratio between expenditure on innovation know-how to GVA Source: Polish CSO's data

Table 4: A capital flow transmission channel in a single company in an opened economy

Outward flow ("u")	Variables	Inward Flows ("i")
Buy securities - S_u / Y : **Inside country transactions** S_{du} / Y - a domestic company buys securities in domestic markets issued by domestic market participants **Cross-border transactions** S_{cu} / Y - a domestic or foreign company buys securities in foreign markets issued by domestic market participants - a domestic or foreign company buys securities in domestic markets issued by foreign market participants -a foreign company buys securities in domestic markets issued by domestic market participants	**Securities** $\Delta S_d / Y$ and $\Delta S_c / Y$ where $\Delta S_d / Y = (S_{di} + \Delta S_{du}) / Y$ And $\Delta S_c / Y = (S_{ci} + S_{cu}) Y$	**Issue shares and bonds** S_i / Y **Inside country transactions** S_{di} / Y **-a** domestic company issues securities in domestic markets issued by domestic market participants **Cross-border transactions** S_{ci} / Y - a domestic or foreign company issues securities in foreign markets issued by domestic market participants - a domestic or foreign company issues securities in domestic markets issued by foreign market participants - a foreign company buys securities in the domestic markets issued by domestic market participants
Take deposits $\Delta D_u / Y$ **Inside country transactions** D_{du} / Y **a** domestic company takes deposits from domestic financial intermediates in domestic markets **Cross-border transactions** D_{cu} / Y - a domestic or foreign company takes deposits from foreign financial intermediates in domestic or foreign markets - a foreign company takes deposits to domestic financial intermediates in domestic or foreign markets - a domestic company takes deposits from domestic financial intermediates in foreign markets	**Deposits** $\Delta D_d / Y$ and $\Delta D_c / Y$ where $\Delta D_d / Y = (D_{di} + D_{du}) / Y$ and $\Delta D_c / Y = (D_{ci} + D_{cu}) Y$	**Give deposits** $\Delta D_i / Y$ **Inside country transactions** D_{di} / Y a domestic company gives deposits to domestic financial intermediates in domestic markets **Cross-border transactions** D_{ci} / Y -a domestic or foreign company gives to foreign financial intermediates on domestic or foreign markets -a foreign company gives deposits to domestic financial intermediates on domestic or foreign markets -a domestic company takes deposits from domestic financial intermediates on foreign markets

Outward flow ("u")		Inward Flows
Inside country transactions $\Delta C_{d,i} / Y$ **Exogenous way** **Credits/Loans** -given credits/loans by domestic intermediates to domestic companies **Corporate bonds** - purchase of corporate bonds in domestic markets issued by domestic firms or their domestic subsidiaries **Endogenous way** **Inter-company loans** -given inter-company loans from one domestic company to another domestic company located in a domestic country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent) **Trade credits** -given trade credits to one domestic company to another domestic company located in a domestic country(relation producer and supplier of inputs: parent and subsidiaries, or two subsidiaries, or subsidiary and parent) **Cross-border transactions** $\Delta C_{c,i} / Y$ **Exogenous way** **Credits/Loans** -given credits by foreign financial intermediates to domestic or foreign companies -given credits/loans by domestic intermediates to foreign companies **Corporate bonds** -purchase its corporate bonds in domestic markets issued by domestic firms' foreign subsidiaries or foreign companies -purchase its corporate bonds in foreign markets issued by its foreign subsidiaries or the domestic company itself. **Endogenous way** **Inter-company loans** -given inter-company loans from one domestic company to another foreign company (or vice versa) located in a domestic country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent) -given inter-company loans from one domestic company to another foreign company located in a foreign country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent)	**Credits/Loans** $\Delta C_d / Y$ and $\Delta C_c / Y$ Where $\Delta C_d / Y = (C_{di} + C_{du}) / Y$ and $\Delta C_c / Y = (C_{ci} + C_{cu}) Y$	**Inside country transactions** $\Delta C_{d,u} / Y$ **Exogenous way** **Credits/Loans** -taken credits/loans by domestic intermediates to a domestic company **Corporate bonds** -issue its corporate bonds in domestic markets issued by domestic firms or their domestic subsidiaries **Endogenous way** **Inter-company loans** -taken inter-company loans from one domestic company to another domestic company located in a domestic country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent) **Trade credits** -taken trade credits to one domestic company to another domestic company located in a domestic country (relation producer and supplier of inputs: parent and subsidiaries, or two subsidiaries, or subsidiary and parent) **Cross-border transactions** $\Delta C_{cu} / Y$ **Exogenous way** **Credits/Loans** - taken credits from foreign financial intermediates to a domestic or foreign company - taken credits/loans from domestic intermediates by a foreign company **Corporate bonds** -issue its corporate bonds in domestic markets issued by domestic firms' foreign subsidiaries or a foreign company -issue its corporate bonds in foreign markets issued by its foreign subsidiaries or the domestic company itself **Endogenous way** **Inter-company loans** -taken inter-company loans from one domestic company to another foreign company (or vice versa) located in a domestic country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent) **-taken inter-company loans from one domestic company to another foreign company (or vice versa) located in a foreign country (relation parent and subsidiaries or two subsidiaries or subsidiary and parent)**

Trade credits 7) given trade credits from one domestic company to another foreign company (or vice versa) located in a domestic country (relation parent and subsidiaries, or two subsidiaries or subsidiary and parent) 8) given trade credits and loans from one domestic company to another foreign company (or vice versa) located in a foreign country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent)	**Trade credits** 7) given trade credits from one domestic company to another foreign company (or vice versa) located in a domestic country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent) 8) given trade credit loans from one domestic company to another foreign company (or vice versa) located in a foreign country (relation parent and subsidiaries, or two subsidiaries, or subsidiary and parent)

Source: Author's own analysis

Table 5: Summary Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
TFP OLS	overall	3.106888	0.3750766	2.113672	4.421537	N = 264
	between		0.2951502	2.679415	3.895798	n = 22
	within		0.239242	2.451521	4.032517	T = 12
TFP Index	overall	1.771087	0.597719	-0.0755338	4.223705	N = 264
	between		0.4926736	0.3206715	2.507235	n = 22
	within		0.3532151	0.6751862	3.837377	T = 12
Lag of Log of Investments	overall	0.353269	0.054645	0.1733913	0.4305449	N = 264
	between		0.052806	0.1797814	0.41839	n = 22
	within		0.0177488	0.2873273	0.4032933	T = 12
Openness	overall	1.822604	0.1146394	1.353564	2.038707	N = 264
	between		0.1094287	1.467546	1.975869	n = 22
	within		0.040887	1.708623	1.99644	T = 12
SD/GVA	overall	0.962239	0.026397	0.894628	1.043735	N = 264
	between		0.023384	0.921426	1.010729	n = 22
	within		0.013147	0.921039	1.055707	T = 12
BCL1/GVA	overall	0.894251	0.046917	0.631311	1.009945	N = 264
	between		0.040221	0.81288	0.963662	n = 22
	within		0.025517	0.712682	0.982965	T = 12
BCL2/GVA	overall	0.922067	0.029983	0.814068	1.000212	N = 264
	between		0.023058	0.878966	0.963079	n = 22
	within		0.019737	0.827074	0.998665	T = 12
BCL/GVA	overall	1.816318	0.064649	1.598273	1.970618	N = 264
	between		0.055598	1.725231	1.900265	n = 22
	within		0.034894	1.661107	1.949104	T = 12
TD/GVA	overall	1.93218	0.047771	1.822693	2.092512	N = 264
	between		0.042868	1.846952	2.017626	n = 22
	within		0.022831	1.840898	2.025495	T = 12
ICL/GVA	overall	0.825344	0.045071	0.748798	0.998751	N = 264
	between		0.040237	0.763683	0.938389	n = 22
	within		0.02191	0.748398	0.889325	T = 12
CL/GVA	overall	4.573842	0.122998	4.261639	4.943196	N = 264
	between		0.108421	4.3461	4.748628	n = 22
	within		0.062169	4.305122	4.808078	T = 12
VP1/GVA	overall	4.130955	3.080084	1.230789	19.25046	N = 264
	between		2.833967	1.462868	12.65184	n = 22
	within		1.338454	-2.14672	10.72957	T = 12
VP2/GVA	overall	0.081843	0.167649	-1.06341	0.823682	N = 264
	between		0.085101	-0.08437	0.310854	n = 22
	within		0.145489	-0.8972	0.73055	T = 12
VP3/GVA	overall	0.081897	0.165613	-1.03209	0.823663	N = 264
	between		0.083597	-0.08152	0.311015	n = 22
	within		0.143985	-0.87334	0.728048	T = 12
UP1/GVA	overall	0.00278	0.007895	0	0.098163	N = 264
	between		0.004063	0.000175	0.014332	n = 22
	within		0.00682	-0.01062	0.091143	T = 12
UP2/GVA	overall	0.00359	0.008621	0	0.054264	N = 264
	between		0.007617	0.000157	0.036209	n = 22
	within		0.004329	-0.01578	0.035888	T = 12

Source: Polish CSO's manufacturing sector data

Table 6: Difference in Difference results analyse the relation between De Facto CAL measures, joint effect of sector liquidity dependent (on/off) and CAL transmission channels and TFP OLS

	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	SD/GVA	BCL1/GVA	BCL2/GVA	BCL/GVA	TD/GVA	ICL/GVA	CL/GVA	VP1/GVA	VP2/GVA	VP3/GVA	UP1/GVA	UP2/GVA
Log of Investment / GVA (t-1)	2.040**	2.651***	1.624*	2.986***	1.047	1.228	1.968**	-0.520	2.087*	2.081*	1.658*	1.657
	(0.783)	(0.793)	(0.752)	(0.839)	(0.626)	(0.734)	(0.634)	(0.673)	(0.867)	(0.866)	(0.777)	(0.855)
Openness (t)	-0.842	-1.572**	-1.088**	-1.006*	-0.878	-2.292***	-1.029**	-2.597***	-1.631***	-1.634***	-2.042***	-1.761***
	(0.484)	(0.527)	(0.379)	(0.461)	(0.446)	(0.470)	(0.358)	(0.346)	(0.486)	(0.486)	(0.521)	(0.492)
IMF(t)	0.082	0.057	0.197***	0.108	0.194***	0.095	0.172***	0.120*	0.072	0.073	0.090	0.075
	(0.052)	(0.053)	(0.052)	(0.055)	(0.057)	(0.050)	(0.051)	(0.048)	(0.054)	(0.054)	(0.054)	(0.055)
Chat Liquidity I (t)	0.475*	0.693***	0.245	0.525**	0.485**	0.646***	0.437**	0.667***	0.638**	0.637**	0.527**	0.576**
	(0.209)	(0.195)	(0.153)	(0.201)	(0.162)	(0.185)	(0.151)	(0.144)	(0.194)	(0.193)	(0.188)	(0.197)
CAL Sector (t)	-8.164***	-1.089	-5.179***	-2.303***	-6.060***	-2.900***	-2.216***	-0.076***	0.310	0.310	-12.554**	-1.190
	(1.401)	(0.789)	(1.113)	(0.593)	(0.761)	(0.752)	(0.224)	(0.007)	(0.207)	(0.213)	(3.782)	(3.177)
Chat Liquidity * CAL Sector(t)	0.144	-0.594**	0.277*	-0.038	0.050	0.775	0.049*	0.012	0.379*	0.378*	10.785**	-7.207
	(0.118)	(0.187)	(0.137)	(0.115)	(0.033)	(0.526)	(0.024)	(0.020)	(0.191)	(0.192)	(3.914)	(6.816)
Constant	11.307***	5.353***	8.803***	7.459***	15.448***	8.735***	13.930***	7.978***	4.706***	4.713***	5.724***	5.120***
	(1.261)	(0.789)	(1.118)	(0.984)	(1.415)	(1.208)	(1.083)	(0.608)	(0.762)	(0.761)	(0.858)	(0.771)
Yearly Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sector Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	264	264	264	264	264	264	264	264	264	264	264	264
R-sq	0.860	0.826	0.850	0.847	0.884	0.841	0.891	0.901	0.829	0.829	0.826	0.813
AIC	-222.053	-165.289	-203.475	-198.137	-272.640	-188.820	-288.063	-313.758	-170.114	-169.283	-164.623	-146.314
BIC	-93.319	-36.554	-74.741	-69.403	-143.906	-60.086	-159.329	-185.023	-41.380	-40.548	-35.888	-17.580

Notes: Robust standard errors in brackets; * p<0.05, ** p<0.01, *** p<0.001-reject the Null. The sample is a panel for period between 1996 and 2007. The dependent variable is the parametric measures TFP OLS based on the Gross Value Added. IMF is on/off CAL measure on the country level, Log of Investment/GVA is the log of Investments on fixed assets per Gross Value Added in sector over time, Openness is log of the sum of export and import per Gross Value Added, Chat Liquidity I is on/off sector-level measure of liquidity needs based on Cash Conversions Cycle, *Source:* Polish CSO's manufacturing sector data

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